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Table of Contents

Vol. 40, No. 46 — March 28, 1942

News Developments

Trends: Tank Cars Become Industry's Backlog in Transportation ... 53
War Gives Refining New Spot in Nation's Economic Program ... *W. T. Ziegenhain* 54
Exploration Has Been Reduced by Restrictions Under M-68 ... *W. V. Howard* 56
This Week ... 57
Synthetic-Rubber Production Will Be 300,000 Tons in 1942 ... 57
Agitation Spreading for Pooling Oil Equipment ... 58
OPC Moves to Hasten Decisions on Pleas for M-68 Exceptions ... 58
Journal Survey of Opinion ... 59
News From the State Capitals ... 60
Editorial: Needed Legislation ... 61
Pipe Lines May Help Solve East Coast Supply Problem ... *Paul Reed* 62
More Drastic Curtailment Needed on Eastern Coast ... *J. P. O'Donnell* 66
Card Rationing System Expected in Six Weeks ... *Henry D. Ralph* 66
Condensate and Natural Gasoline Included in April Quotas ... 67
Refiners May Be Forced to Increase Fuel-Oil Yields ... *H. Stanley Norman* 68
Many Problems Face Industry in Its All-Out War Effort ... *C. L. Henderson* 70
House Hearing Opponents of Cut in Depletion Allowance ... 71
Oil Shippers Submit Data on Harm of Rail-Rate Increase ... 71
Deaths ... 72
The Markets ... 72
Panhandle A.P.I. Attracts 600 ... 72
International News ... 75
Natural Gas News ... 76
Natural Gasoline News ... 76
Recycling News ... 76
Refinery Activity and Expansion ... 243
Pipe-Line Activity ... 246
Arkansas Smackover Lime Pools Have Large Sour-Gas Reserves ... 250
A.S.M.E. Meeting in Houston Attracts Large Attendance ... 275
Interstate Oil Movement Reflects Dislocations ... 276
Texas Panhandle Feeling Effects of War-Brought Regulation ... *Harry F. Simons* 277

Refinery Section

Experiences of Operating a Refinery in War Area ... 78
Propane—A Substitute for Butane in Motor Oil ... *R. C. Alden, H. M. Trimble and L. A. McReynolds* 80
Gasoline Additives ... *Joseph A. Moller* 82
Are We on the Threshold of a Petroleum Chemical Industry ... *W. L. Nelson* 85
New Ideas in Motor Control ... *M. A. Hyde* 86
Performance Value of High-Octane Aviation Gasolines ... *G. A. C. Leaver* 88
One-Man Fire-Fighting Equipment in Refinery ... 93
Flow Charts for the Synthesis of Aviation Gasoline ... 95, 98, 103, 106, 111
Refinery Ideas that Save $$$ ... 96, 101, 104, 124, 145, 148
Thermodynamics in Isomerization ... *Paul Buthod and W. L. Nelson* 120
Butadiene Is Real Bottleneck in Synthetic-Rubber Program ... *J. P. O'Donnell* 128
Catalytic Desulfurization by Use of the Gray Process ... *A. M. Martin and L. Carlson* 138
Refineries Operating in the United States ... 152
Refineries Operating in Mexico ... 156
Refineries Operating in Canada ... 158
Shutdown Plants in the United States ... 158
Buyers' Guide of Refinery Equipment ... 161

Engineering—Operating

Effective Camouflage as Means of Protecting Oil Property ... *K. J. Keating* 225
Automatic Tank-Battery Control Simplifies Lease Operation ... *Harry F. Simons* 227
High Gas Pressures Controlled at Alice ... *Neil Williams* 229
Operating Ideas ... 231
Cost Engineering: Replacement Calculation Using Sinking Fund Depreciation ... 233
Cost Engineering: Gas-Drive Efficiency Determined by Injection Ratio ... 235
Engineering Fundamentals: Density of Oil-Field Liquids ... 237
Engineering Fundamentals: Control of Mud-Fluid Column Pressure to Subdue Formation Pressure ... 239
Safety: Metal Handles Prevent Hand Injuries ... 241

Field Developments

Field Developments ... 249
North Central Texas ... *D. H. Stormont* 252
California ... *L. P. Stockman* 255
Texas Gulf Coast ... *F. L. Singleton* 257
Permian Basin, Panhandle ... *Robert Ingram* 259
Appalachian Fields ... 260
Kansas, Nebraska ... *Carl Hoot* 261
Southwest Texas ... *F. L. Singleton* 262
Illinois ... 264
Louisiana Gulf Coast ... *F. L. Singleton* 265
North Louisiana-Arkansas ... 266
Eastern Texas ... *Robert Ingram* 266
Ohio, Indiana, Kentucky ... 268
Oklahoma ... *Carl Hoot* 269
Among Drilling Contractors ... 270
Michigan ... *Otto C. Pressprich* 277
Rocky Mountain Area ... *T. R. Ingram* 277
Canada ... *Victor Lauriston* 278

Markets and Prices

Group 3 Market ... 282
New York Market ... 282
A.P.I. Refinery Report ... 282
Gulf Coast Market ... 282
Refinery and Tank-Wagon Prices ... 283
Crude-Oil Prices ... 283

Additional Features

Personal Paragraphs ... 280
Equipment News ... 285
Classified Advertising ... 286
Advertisers' Index ... 288

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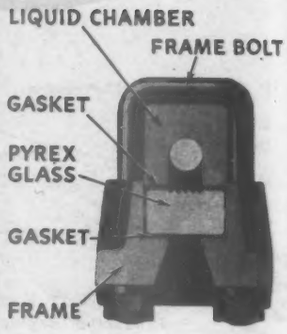

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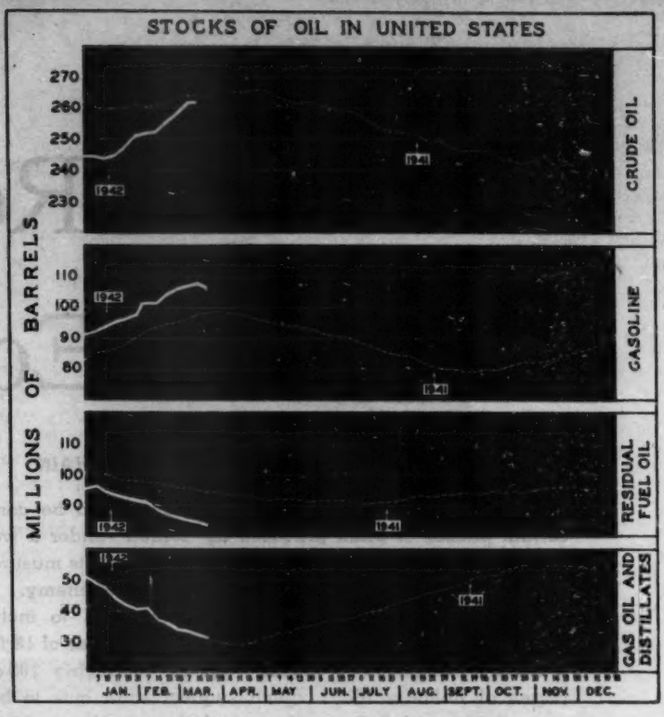
Trends

Tank Cars Become Industry's Backlog In Transportation



AS committees representing all branches of the oil business and the Washington war agencies meet from week to week to find solutions to transportation and closely allied problems, tributes to the industry's tank cars and their owners are heard. Many times in recent weeks tank-car shipments have been the only way out to conditions brought about by a tanker shortage in the coastwise movement of petroleum products. As probable conditions in the industry later in the year are studied it is apparent that tank cars will be needed in increasing numbers. In recent years the attitude of the industry has been that the rail movement of crude oil or products was outmoded and would decline to a small percentage of its former position as transportation by pipe line, tankers and barges, and trucks expanded. Fortunately there has been no general junking of tank cars so that approximately 150,000 are now available to maintain normal shipments and to carry on a record movement from the Middle West and Southwest to the East and from California to the Northwest. Detailed studies have been made which will lead to some expansion in the inland-water and pipe-line movement of petroleum through the spring and summer months but every analysis has emphasized the fact that millions of petroleum consumers in important areas will be largely dependent on rail movements until tanker transportation becomes normal. Latest reports show that the rail shipments to Atlantic seaboard states now total nearly 450,000 bbl. daily and surveys are being made with plans to increase this movement to 600,000 bbl. daily or more.

CRUDE PRODUCTION *3,681,470 bbl. daily average—up 154,890 bbl. One year ago 3,685,380 bbl.*

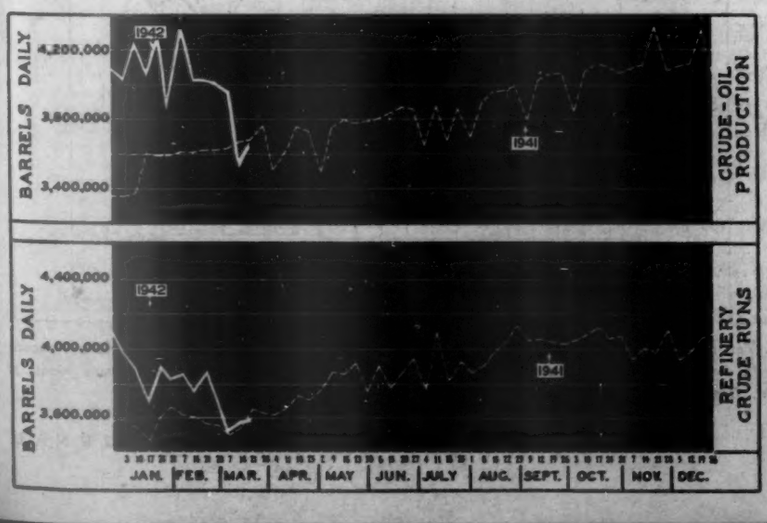
CRUDE STOCKS *262,063,000 bbl. as of March 14—up 1,999,000 bbl. One year ago 264,304,000 bbl.*

GASOLINE STOCKS *106,131,000 bbl. as of March 21—down 1,098,000 bbl. One year ago 98,723,000 bbl.*

RESIDUAL FUEL-OIL STOCKS *84,025,000 bbl. as of March 21 — down 1,464,000 bbl. One year ago 94,141,000 bbl.*

GAS OIL AND DISTILLATES *32,290,000 bbl. as of March 21—down 541,000 bbl. One year ago 31,338,000 bbl.*

REFINERY RUNS *3,599,000 bbl. daily week ended March 21 — up 11,000 bbl. One year ago 3,653,000 bbl.*



DAILY AVERAGE PRODUCTION FOR WEEK

	Mar. 21, 1942	March OPC recommended production	Mar. 14, 1942
Arkansas	76,575	71,500	70,500
California	629,250	627,000	643,150
Eastern fields	111,500	108,500	113,200
Illinois	323,380	362,500	321,140
Kansas	228,750	245,800	234,400
Louisiana	332,835	314,700	333,635
North Louisiana	*80,535*	.....	*80,935*
Louisiana Gulf Coast	*252,300*	.....	*252,700*
Michigan	46,100	49,500	50,900
Mississippi	90,330	53,100	90,065
Nebraska	4,150	5,100	4,050
New Mexico	115,420	100,200	114,880
Oklahoma	390,350	405,300	396,250
Rocky Mountain states	116,830	107,900	113,910
Texas	1,216,000	1,138,600	1,040,500
East Texas	*293,000*	.....	*219,750*
West Texas	*182,450*	.....	*146,450*
North Central Texas	*148,600*	.....	*139,150*
East Central Texas	*84,550*	.....	*78,500*
Texas Panhandle	*84,300*	.....	*75,900*
Texas Gulf Coast	*346,100*	.....	*306,800*
Southwest Texas	*77,000*	.....	*73,950*
Total United States	3,681,470	3,589,700	3,526,580

Total production, Jan. 1-Mar. 21, 1942..... 321,139,590 bbl.
Same period last year ..... 286,630,035 bbl.

While producers, refiners, and jobbers have not hesitated in using tank cars to supply demands there is widespread concern as to whether OPA will grant adequate price increases to offset additional costs. One of the difficulties in making price adjustments lies in the fact that increased costs to shippers are not uniform. Cases are cited in which the variation in rail charges in the delivery of gasoline to one point have varied ½ cent or more per gallon. This is due to variations in distances and the fact that existing petroleum rates have not been coordinated to meet changed conditions in the movement of petroleum products. It has been indicated at Washington that any price changes will be uniform and will be added to the present price structure which is based on comparative transportation costs between areas which no longer prevail. These conditions are pointed to as necessitating a pooling arrangement which will assure, so far as possible, that higher costs due to tank-car transportation will be uniform with offsetting return to shippers.

War Gives Refining New Spot In Nation's Economic Program

By W. T. ZIEGENHAIN

No summary of current refining operations could be complete without recognizing certain phases of plant practices as "forced" under a wartime economy. Likewise, certain technical phases of current developments must remain undisclosed in order to avoid giving possible aid or comfort to the enemy. With these limitations in mind, the Refinery Number has been compiled to include a series of technical features starting on Page 77, followed by a series of 18 flow charts which diagrammatically outline the practical ways for producing 100-octane aviation fuels, five pages of Refinery Ideas which suggest short cuts to better efficiency and economy, the annual Refinery Survey of plants in North America and a Buyers' Guide of Plant Equipment.

THE routine of oil-refining operations has been changed by the war to such a great extent it is no longer practicable to refer to the experiences of the 451 operating plants as a whole. Indeed, the war and its attendant economics are causing refiners to be grouped into either of two classes; those with government contracts and those without.

The large number of operating units is accounted for by many small plants, operating at scattered points throughout two-thirds of the states of the country. Because many are relatively small, the particular plant often finds itself unable to justify the erection of equipment that will permit it to make the kinds of products the Government is buying to carry on the war.

This lack of justification is apparent from two facts: (1) The smaller plant, which is equipped only to make ordinary motor fuels, distillates and residuum fuel oils, cannot recover sufficient individual hydrocarbons, such as butane, to operate a unit designed to make aviation gasoline for the Government; (2) the shortage of steel makes it imperative that these special units, designed to synthesize aviation fuels from individual hydrocarbons, be built large enough to get the greatest unit capacity from each ton of metal available.

Under the direction of the OPC, and through the offices of Wright Gary, a flow chart for a "war refinery" has been developed, and reference to it (see p. 18, issue March 19) clearly shows how greatly this operation varies from the routine peacetime operations of plants. In the war plant, the production of alcohols, styrene, butadiene, toluene and aviation alkylates is listed as essential, along with motor gasoline and domestic fuels.

It soon becomes obvious that the average refinery cannot install the equipment to accomplish this end, nor is it the plan of the Government's agents to suggest it. But small refinery operations can be modified to help supply basic charging stocks for isomerization units, alkylation plants and similar equipment, built in centralized locations, and that is the plan at present.

Some units are well along the road toward completion for the manufacture of components for 100-octane aviation gasoline, while others are simply on the drafting boards. Maximum attention is given these units which are nearest completion, and there appears to be no doubt but that the needs of the Government will be met well in advance.

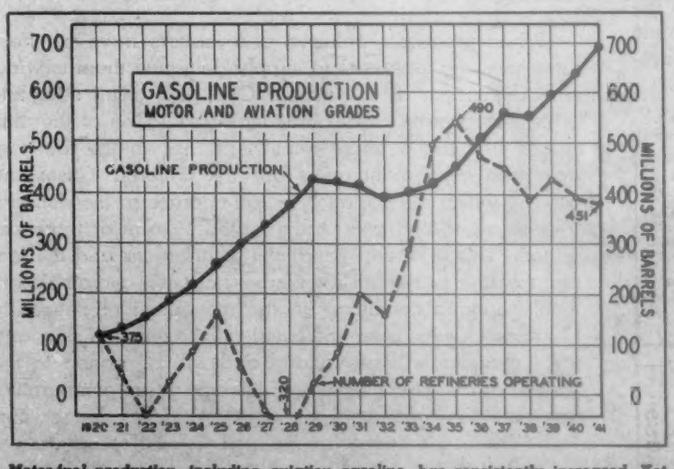
Growth of Refining Capacity in the United States

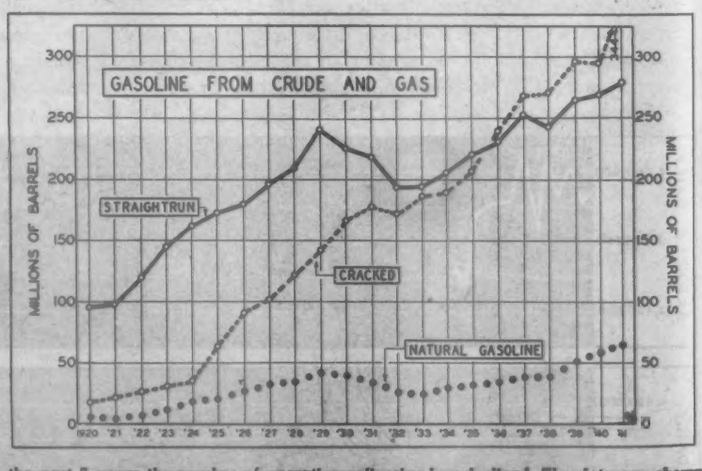
	All Plants		Operating Plants	
	No.	Capacity (bbl./day)	No.	Capacity (bbl./day)
1914	178			
1918	287	1,186,155		
1919	289	1,295,115		
1920	373	1,530,565		
1921	415	1,888,800		
1922	479	2,164,050	325	1,854,590
1924	574	3,048,790	362	2,549,490
1925	584	3,033,882	385	2,680,052
1926	515	3,068,340	358	2,770,340
1927	462	3,224,307	328	2,964,427
1928	456	3,426,330	315	3,116,930
1929	463	3,719,550	341	3,454,250
1930	479	3,972,480	382	3,721,360
1931	500	4,164,080	397	3,913,180
1932	510	4,093,370	383	3,865,830
1933	567	4,125,250	424	3,896,410
1934	628	4,243,093	483	3,790,593
1935	667	4,281,894	496	3,815,470
1936	640	4,301,754	479	3,936,535
1937	603	4,277,880	471	4,038,010
1938	562	4,511,160	451	4,301,910
1939	560	4,461,120	485	4,191,055
1940	534	4,665,319	462	4,438,858
1941	548	4,816,715	459	4,524,775
1942	525	5,019,815	451	4,773,635

Isobutane Most Important

One of the most vital fractions of the crude oil, sought by refiners to carry on the work of synthesizing 100-octane aviation gasoline and provide a base stock for the manufacture of synthetic rubber, is isobutane. By use of exceptionally efficient fractionating equipment, the average refiner and natural-gasoline manufacturer can recover small percentages of this hydrocarbon from his gasoline production. It is especially difficult to separate the isobutane and the normal butane, but if they should be recovered in the combined form, the percentage recovered, based upon the charge, would still remain small.

In order to effectively carry out the nation's 100-octane-aviation-gasoline program and also supply the base stocks for synthetic rubber, authorities have indicated that it will be necessary to refine more crude oil. One has indicated the need





Motor-fuel production, including aviation gasoline, has consistently increased. Yet, in the past 7 years the number of operating refineries has declined. The data are shown in the chart at the left. Since refiners are producing synthetic toluene, glycerin, benzene, isooctane, butadiene, styrene, etc., the trend toward larger and fewer plants is substantiated. The application of cracking is revealed in the chart at the right. Cracking has prepared the way for the many synthetic processes of today

for an increase of 500,000 bbl. in the daily capacity. This will probably be supplied among the larger refining units when and as the war needs assert themselves. Disposition of the heavy oils will be a problem.

This conclusion seems well founded because of the experiences gained in peacetime. Reference to the accompanying table and charts will reveal the trend toward larger but fewer refineries for the past 7 years. On March 1, 1935, the industry reached a peak of 496 operating refineries. These had a combined capacity of 3,815,470 bbl. of crude daily. On the same date this year, the number of operating plants is shown as 451, but their combined capacity is 4,773,635 bbl. So, in the past 7 years the number of operating refineries has declined 9 per cent but the combined operating capacity of the plants has increased 25 per cent.

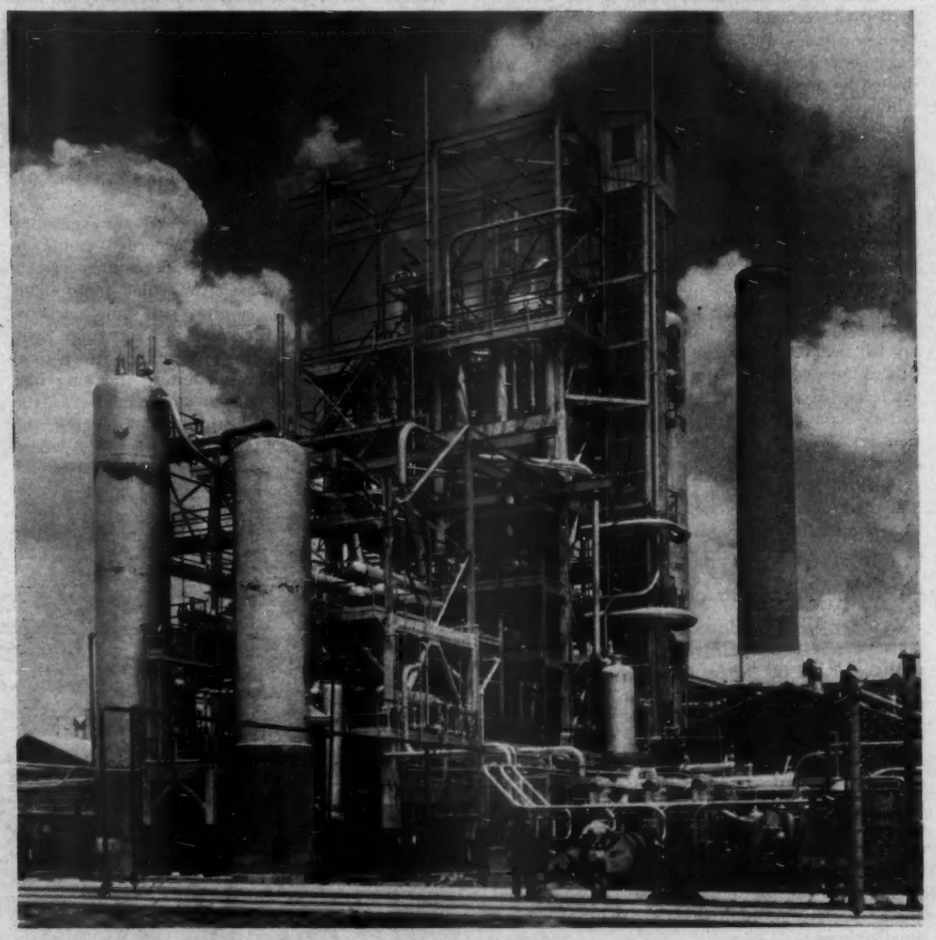
A large proportion of this increased capacity is accounted for among refineries located in the Gulf Coast. Substantial increases also occurred in the plants around Chicago in what is known as the Illinois-Indiana area. Less than average increases are shown by the eastern or New Jersey refineries, the California plants and those in the Mid-Continent. For example, the Illinois-Indiana group had a combined capacity in 1935 of 314,600 bbl. per day. At present, that group has a capacity of 508,500 bbl. That tabulation is significant of the large increase which came to the Mid-West interior plants while the relatively small increase which came to Kansas is typical of the experiences of Mid-Continent plants.

California has shown an increase from 784,750 bbl. capacity in 1935 to 829,150 bbl. now. It is significant also that California currently contains the largest number of idle plants. Most of these are skimming plants, designed to process local crude and are not well situated to carry out the present program of large-scale syntheses.

Texas, of course, as a whole, contains the largest number of operating plants and shows the largest gain in combined plant capacity over the period. Here the total has increased from 992,790 bbl. in 1935 to 1,422,000 bbl. at present.

Refineries Operating in North America

	Number	Daily crude capacity (bbl.)
UNITED STATES:		
Alabama	1	4,000
Arkansas	5	37,500
California	58	829,150
Colorado	9	17,075
Delaware	1	3,500
Georgia	1	4,000
Idaho	2	2,300
Illinois	20	276,050
Indiana	10	232,450
Kansas	22	177,200
Kentucky	9	53,850
Louisiana	14	217,200
Maryland	3	52,500
Massachusetts	2	54,860
Michigan	24	95,300
Minnesota	2	7,500
Missouri	2	25,100
Mississippi	2	7,000
Montana	27	47,970
Nebraska	8	9,425
New Jersey	6	251,700
New Mexico	8	9,150
New York	7	71,550
Ohio	11	189,500
Oklahoma	23	196,580
Pennsylvania	29	360,300
Rhode Island	2	9,000
South Carolina	1	6,000
South Dakota	4	410
Tennessee	1	3,500
Texas	94	1,422,000
Utah	3	11,000
Virginia	1	2,000
Washington	2	4,100
West Virginia	5	13,200
Wisconsin	1	6,000
Wyoming	33	61,615
Total	451	4,773,635
CANADA:		
Alberta	14	18,250
British Columbia	4	43,400
Manitoba	5	3,750
New Brunswick	1	250
Northwest Territories	1	850
Nova Scotia	1	32,500
Ontario	6	67,600
Quebec	5	67,300
Saskatchewan	9	15,450
Total	46	250,350
MEXICO:		
Total	12	150,495
NORTH AMERICA	509	5,023,985



Typical of the plants being built for the synthesis of high-octane aviation fuels is this 10,000-bbl. Polyform unit. It was recently placed in operation at one of the large refineries along the Gulf Coast

100-Octane Motor Fuels

The federal Government's request for large, sustained supplies of 100-octane aviation gasoline comes as a result of its program to build and maintain 60,000 or more modern bombers and fighter planes this year. This number has been doubled for 1943.

The industry is preparing to supply the fuel well in advance of actual needs. Butane will be supplied to central isomerization plants where it will be converted to isobutane. Then, in those same areas, the material will be converted to the alkylate by polymerizing it with current supplies of butylene. Because butylene is a product of thermal cracking, and because there is general application of this type, the supply of butylene is adequate to fill all projected needs.

The expenditure for equipment needed to carry out this program will approximate ⅓ billion dollars or about 6⅔ times the normal annual expenditure made by refiners for prefabricated refinery units. In metals, the program will call for the consumption of at least ⅓ million tons of steel, iron, chromium, nickel, copper, zinc and tin.

Synthetic Rubber

The other major program to be undertaken by refiners is the production of butadiene, styrene and isobutylene for the manufacture of synthetic rubbers.

The recovery of butadiene from the dehydrogenation of butane and the synthesis of styrene and isobutylene in the required quantities necessitates concentrating operations in relatively few units. Already major units are being designed for assembly at points widely spaced across the United States, and within the year supplies of butane will be moving to these points for conversion and copolymerization.

The refining industry finds itself in competition with the coal-tar industry to supply the styrene and butadiene, but this has not greatly retarded either in hastening plans to supply what it can in the least possible time. As the situation stands, it looks as though the two industries will build supplies to produce at least 400,000 tons of suitable rubber substitutes by the end of 1943.

The refiners' portion of this program will call for the expenditure of at least $400,000,000.

Exploration Has Been Reduced By Restrictions Under M-68

By W. V. HOWARD

THE purposes of M-68 and P-98, both stated and implied, are to conserve steel by saving unnecessary wells, to develop new reserves by stimulating the drilling of wildcats so that if, as and when there is an increased demand for oil, an additional supply will be available.

There is no question but that much steel that would have gone into oil wells has been saved but many operators doubt whether the wells not drilled can be called unnecessary. There has also been a considerable saving of steel which might have gone into successful wildcats and new wells drilled as a result of these successes because the wildcats are not being drilled at the 1941 rate, to say nothing of an increased rate. Theoretically, a restriction on development wells should call for some increase in wildcatting but this has not been the case. Some companies are more active in exploration than ever, while others have only one string of tools running, or none. Recent reports from the fields state that one of the most active companies in the Rocky Mountain district has not a single rig in operation in the district.

Some operators who would drill wells are held up by the difficulty of interpreting the rules. Others foresee difficulties later if they drill offset leases according to the rules and later have to face damage suits on drainage and other difficulties. They may win the suits but even a successful defense costs money and time. It is simpler to apply for an exception so that a normal offset can be drilled, get turned down and thus maintain the lease in force at least until the suspension of the regulations.

Financing of Wildcats

Whether operators increase their wildcat operations or not depends mainly on their financial status and on the areas in which they operate. This is as true of the major oil company as of the small independent. The operator with production has heavy taxes to meet. He can reduce these taxes by exploratory work which, if successful, will improve his future position. If his profits from production are sufficient, he can drill his dry holes for about 25 cents on the dollar. With development costs restricted because of the 40-acre spacing requirements, expenditures on wildcatting can be made more advantageously during periods of high taxation than during ordinary times.

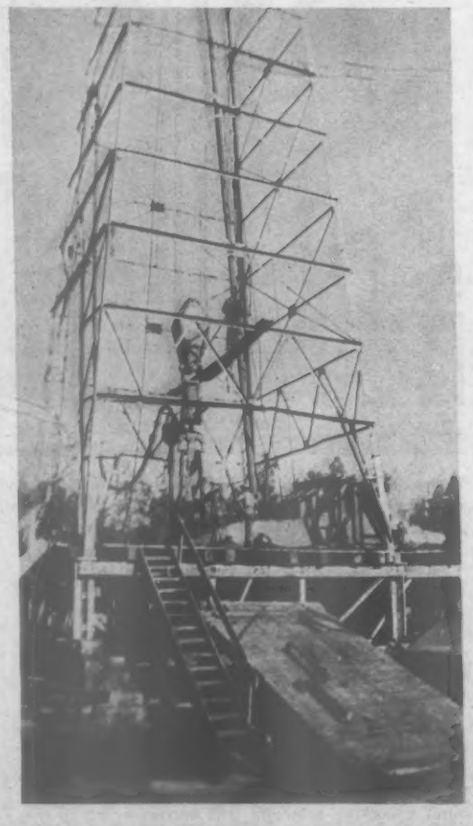
As an index of the importance of tax considerations, one company trebled its wildcatting campaign during 1941 and expects to increase it still more in 1942. Other companies are sticking to the programs adopted before the new regulations came into effect, but are speeding them up as quickly as possible. In some cases, this is due to a desire to get the work done before some new regulation interferes with the program. In other cases, the idea is to get the wildcatting program out of the way so as to be ready for any emergency that may arise.

Some companies with large blocks of leases on which they have paid rentals will drill these leases during the coming year. The tendency in the past has been to farm out some leases for a well but with development drilling slowing down, there will be an increasing tendency for the lessees to drill their own wells. Opinions regarding deals involving the purchase of eighties or quarter sections in a drilling deal vary. Some operators favor continuing this practice, even on an increased scale while others realize that if they take 160 acres on a play, they will only be able to drill four wells and the cost of operating a property remote from their other operations will influence them against participation.

Areas in which small leases are the rule will see less exploration than those where holdings are larger, according to some observers. The requirement of 40-acre spacing may also retard leasing in some areas where 10-acre spacing has formerly been the rule.

The increased demand for 100-octane gasoline and the favored treatment accorded fields in which the crude yields a large percentage of this fuel naturally favors areas in which these fields may be found. This is offset in some parts of Texas, however, by the small and irregular holdings which makes a uniform spacing pattern hard to apply. Some operators point to the long narrow trend fields in Illinois and Kansas, or the small productive pimples found bordering the Seminole area in Oklahoma as districts where M-68 will definitely hamper exploratory work.

In the case of the trend pools particularly, it is difficult to appraise the chances of success of wells 660 ft. from the discovery at right angles to the trend. The risks are more than doubled when the interval is doubled. Some of the pimples in eastern Oklahoma have not more than 160 productive acres. Such a pool could be so located with respect to boundary lines that there would be only one other similarly situated productive location.



Roberts 1 E. S. Bond, east offset to the discovery well of the Midway field, Lafayette County, Arkansas

Development Drilling

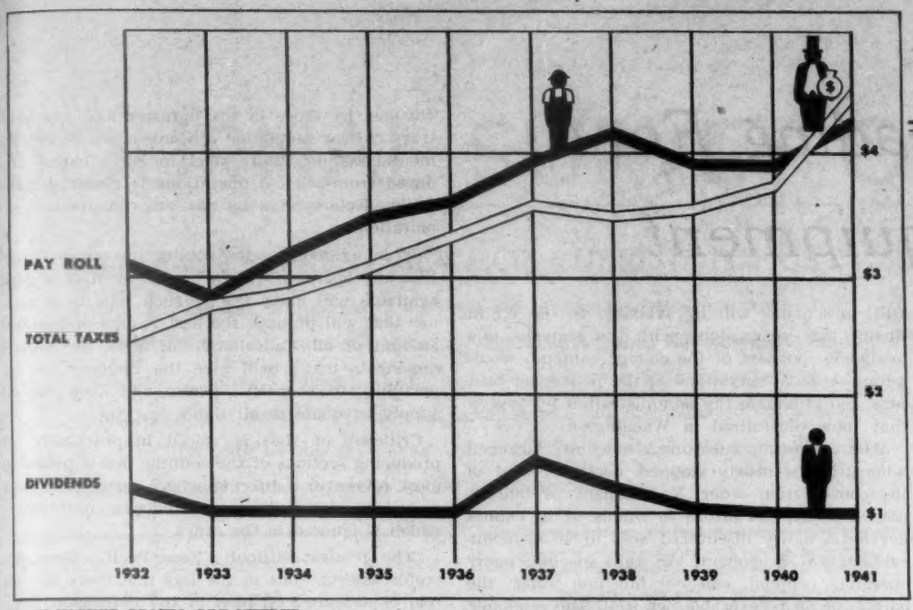
The decline of development drilling in fields where 10-acre spacing has been the rule is also causing much unfavorable comment. Stocks of equipment are piling up which cannot be used because of M-68 in wells which operators feel are vitally needed to maintain reserves. These stock piles may be construed as evidence that the oil industry does not need steel. Then, if, as and when Washington realizes that more oil is needed quickly, supplies will not be available for drilling. Meanwhile a flock of dry wildcats use up steel and produce nothing whereby many locations are known where additional needed supplies could be obtained which would keep existing transportation facilities operating at greatest efficiency.

Some fortunate operators are viewing the whole matter philosophically. They claim that no one in Washington knows what the demand for oil will be. They realize that existing demands can be met with existing wells and that there are more pressing needs for steel than the drilling of additional wells. They feel that when the oil is needed the steel will be forthcoming. By that time major construction work will be slowed down and there will be extra steel capacity.

These theoretical considerations can be discussed indefinitely and each operator is planning his future activities, whether voluntarily or under economic compulsion, according to his conception of his economic future and of the need of the nation for oil.

The net result of all of these views is reflected in surveys of activity, such as the Journal's monthly summaries. These summaries do not reflect the actual status of drilling wells, however, and require some interpretation. The number of wells reported as drilling at the end of any month includes a large number of shutdown wells. They are compiled from scout tickets which, once they start reporting a well, continue to report it as either drilling or shut down until the rig is moved away and the well either abandoned or completed. Some wells have drilled off and on for as long as 10 years and such wells cannot be reported as abandoned at any time. In many cases the shutdown period is only the day on which the scout visited the well. Sometimes the well has actually been abandoned but the rig has not been moved because the driller has no other location to which to move it. Thus, the number of wells reported as drilling must include some shutdown wells which are inactive and will remain so for some time and others which are inactive only for a few days or hours.

(Continued on Page 274)



WHY HIGHER PRICES ARE NEEDED—*THE CHART TAKEN FROM THE UNION OIL CO.'s ANNUAL STATEMENT IS TYPICAL OF THE TRENDS REFLECTED IN MANY OTHER OIL-COMPANY REPORTS. ADVANCING TAXES HAVE PASSED PEAK PAY ROLLS WHILE RETURNS TO INVESTORS CONTINUE AT THE LEVELS OF PREVIOUS YEARS.*

This Week...

Eastern operators declare hemispheric rationing of transportation facilities needed if East Coast fuel-oil supplies are to be adequate next winter. Provided, however, that tanker sinkings continue unabated. Decrease of tanker losses would aid in solving problem.

●

Service-station dealers in eastern states want closing hours made uniform by WPB. Claim chain operators stagger hours, keep retail outlets open 24 hours and thus capture new customers.

●

Tank-car movement of oil to East Coast rises to record of nearly 440,000 bbl. daily, proving previous peak estimates of 350,000 bbl. were too conservative. Rail service to Atlantic seaboard requires upward of 20,000 cars.

●

Transportation executives from Districts 1, 2 and 3 wrestled with problem of supplying East Coast. Considered relaying idle lines, looping others, increasing rail, barge and truck shipments. Concluded national-defense line still best solution. Alternatives must be adopted because WPB refuses to allocate steel.

●

Repair and maintenance order P-88 is headed for scrap heap, along with other blanket preference ratings. Project Ratings Plan to be substituted. Details not apt to develop before mid-June. Until then, P-88 prevails.

●

Coupon gasoline rationing in the 19 states and the District of Columbia is expected in 6 weeks. Details are being worked out by OPA.

●

Appeal for upward adjustment of Panhandle crude prices to parity with Mid-Continent oils rejected by OPA.

●

Opponents of change in depletion tax allowance opened fight against Treasury's proposal for modification. Declared complete abolishment would yield only enough additional revenue from oil industry to run federal Government 16 hours.

●

Retail gasoline prices in curtailment areas, including 19 eastern and northwestern states and the District of Columbia, frozen by OPA at levels of March 13.

●

Eighteen shutdown days in April are in prospect for Texas producers who suffered the most severe cut in quotas certified for next month by OPC. Natural gasoline and recycle condensate included in certified state quotas for first time.

●

Adjustment of product prices to offset the advance of 6 per cent in freight rates sought from OPA. District 2 marketing committee points out that it now costs $10 to $20 more for each tank car of petroleum delivered in Group 3.

●

Capacity for 600,000 tons of synthetic rubber is in various stages of plant negotiation or construction, declares the materials director of WPB. The plants are either under construction or covered by letters of intent. Production will be 300,000 tons in 1943 and 600,000 in 1944. Program subject to further expansion.

●

Marine underwriters advanced rates 25 per cent on coastwise cargoes. Indicates diminishment of losses not yet in prospect.

Synthetic Rubber Production Will Be 300,000 Tons in 1943

WASHINGTON, D. C., Mar. 24.—The rubber situation is desperately critical but with the highest priorities on plants now under contract we will produce 300,000 tons of synthetic rubber during 1943, the Truman investigating committee of the Senate was told today by W. L. Batt, director of materials of WPB.

Plants now under contract or covered by letters of intent will have a capacity of 600,000 tons of synthetic rubber and this goal, he said, should be reached during 1944. He said Leon Henderson was too pessimistic when he declared that we could produce 300,000 tons next year only by a miracle, but agreed that not a single civilian passenger car would get a new tire during the emergency. Mr. Batt said a synthetic-rubber industry, the like of which was never seen before, must be created at once, and the oil industry probably will carry the burden in the long run, though at the start the chemical industry will play a big part. Butadiene is now the bottleneck but this will not interfere with the 100-octane program. The program may go beyond 600,000 tons and will cost from $500,000,000 to $1,000,000,000.

Reviewing the history of the synthetic-rubber program Mr. Batt said that in the summer of 1940 the National Defense Advisory Committee was approached by Standard Oil, Goodyear, Goodrich, Firestone, and later U. S. Rubber, companies with proposals to produce a total of 108,000 tons by various processes. The committee studied these and suggested a 100,000-ton program be financed by the Government, using different processes experimentally. However, Jesse Jones thought the possibility of a natural-rubber shortage very remote and the experimental program too costly and in the fall of 1940 the NDAC turned the whole program over to Mr. Jones. Later, RFC financed four pilot plants of 2,500 tons each but capable of being expanded to 10,000 tons each.

In May 1941 the OPM pressed for more action but the program was not expanded rapidly until Pearl Harbor. Contracts for capacity of 40,000 tons awarded a year ago are well under way, and contracts for 180,000 tons awarded since have advanced with great progress during the last 30 days and a total capacity of 600,000 tons in various stages, Mr. Batt said.

●

Reclaimed Rubber Use Is Curbed

WASHINGTON, D. C., Mar. 23.—Severe restrictions on the use of scrap and reclaimed rubber have been imposed by the War Production Board, prohibiting or curtailing the production of a long list of articles.

After March 31 the use of reclaimed rubber is banned except for the manufacture of products in which crude rubber or latex is permitted. Another list curtails the production of specified products, including low-pressure water and garage air hose.

It was understood in Washington that a consent decree would be filed this week settling the controversy over alleged German control of synthetic-rubber patents held in this country by Standard Oil Development Co. Earlier Thurman Arnold had asked the Truman committee to postpone his appearance until this case could be litigated, and his willingness to testify Thursday was taken as indication a consent decree had been completed and would be filed late Wednesday or simultaneously with his testimony on Thursday.

Agitation Spreading For Pooling Oil Equipment

AGITATION for abolishment or recasting of Conservation Order M-68 is spreading in factions of the oil industry. Some operators are growing more insistent that industry judgment replace Washington regulations in the determination of spacing patterns. Linked to the reasoning and an integral part of suggestions coming from practical operators in several parts of the country is a proposal for pooling steel now in the hands of the industry and that to be made available during the remainder of the war.

Equitable distribution of the pooled materials between the companies and individuals composing the oil industry is proposed. This would be accomplished by allocating supplies on the basis of wells drilled during 1940 or some other representative year.

The most common objection to M-68 is that the curtailment of development activities since December 23, 1941, is definite proof that the order does not accomplish the purpose for which it was designed.

Diversion of experienced drillers to other industries, the inevitable result of curtailed exploration, threatens, observers declare, to leave the industry impotent from a standpoint of man power when the oil business is again called upon to intensify drilling.

It is estimated that there is now available in oil company and mill stocks, enough tubular goods of various sizes and grades to drill and complete 9,000 new wells. This includes only steel that is already formed in pipe and none in billet shapes.

To prevent complete shutdown of drilling and the migration of crews from the industry, a program has been suggested that would overcome most of the objectionable features of M-68, its sponsors say. The plan consists of the following three basic phases:

1. Place all pipe now fabricated and ready for use in a national pipe pool. This would include all stocks, whether company or mill owned. Full credit value would be given to the owners of pipe placed in the pool. The pool then would become the sole source of supply for all pipe used by the industry.

2. Using the year 1940 as an average year (any other period may be used), each and every operator or producer would certify the amount of steel tonnage used for that period. Certification would be under oath with severe penalty for fraudulent reports.

3. The total of the tonnage figures so certified would be the denominator of a fraction, the numerator of which will be the tonnage used by any operator for the period chosen. The resulting fraction would be the part of the total available tonnage in the pipe pool that an operator could use in his operations. If any operator did not use the steel allocated to him in a reasonable, specified time, he would relinquish his claim and the steel would go back into the pool for reallocation to the industry. As the source of steel supply varied, the amount available for use from the pool would change accordingly.

Abolishment or substantial revision of M-68 is advocated by many operators who would substitute the pooling and steel allocation plan for existing restrictions and revitalize the state regulatory bodies as arbiters of spacing patterns.

The 60 per cent of normal steel tonnage that OPC anticipates will be available to the oil industry this year, along with the material now available, sponsors of the change contend, would permit orderly operations in the petroleum business and eliminate the administration by "exception" now centralized in Washington.

M-68 stresses wildcatting. Under it, however, wildcatting is nearly stopped, declare critics of the conservation order. No company or individual, they say, can afford to wildcat if he cannot develop a newly discovered area in an economical manner. Proponents of wide spacing, many operators contend, consider but one thing: the barrels of oil recoverable per well. The economic gage recognized by the industry always has been barrels recovered per acre and not per well.

Proper spacing of wells in already proven areas, it is contended by M-68 opponents, will yield more oil than the few new pools, which may be discovered by wildcatting, can provide if they must be developed on a 40-acre program. The factors which govern proper spacing are variable, they argue, and cannot be controlled or changed by those in the industry and any arbitrary rule or regulation can only work in a detrimental manner. More steel for each barrel produced from wildcat operations is required, M-68 critics declare, than by any other method of exploration.

It is axiomatic, the pooling proponents say, that any operator with a limited amount of pipe available will make use of such pipe in a manner that will produce the best results or greatest amount of oil. Cancellation of M-68, the order's opponents insist, will give the industry an opportunity to properly operate and keep the oil supply adequate at all times.

Criticism of M-68 is voiced in practically all producing sections of the country but is probably most severe in California where many fields are underlain with multiple pay zones, a contingency which is ignored in the order.

"The greatest difficulty," one Pacific Coast operator asserts, "lies in the fact that there are no real experienced oil men in the Petroleum Division of the War Production Board. The oil operators have to depend upon the personnel of the OPC to obtain approval on requests for exceptions from the WPB.

"It seems," he continued, "that the heads of some of these governmental departments are more engrossed in their competition for authority than they are in seeing that the practical problems of the industry are properly met."

OPC Moves to Hasten Decisions On Pleas for M-68 Exceptions

WASHINGTON, D. C., Mar. 23.—Elimination of general Preference Rating P-98, and substitution of the Production Requirements Plan for all "P" orders, was announced late last week by James S. Knowlson, director of industry operations of the War Production Board.

P-98, which was only last week extended and amended, provides priority assistance for maintenance and repair, and operating supplies for the petroleum industry.

Under the new procedure, a specific requirements approach to the control and distribution of scarce materials will replace the use of general or blanket priority rating orders as rapidly as the necessary new orders and procedure can be put into effect. Between April 1 and June 30 most of the blanket rating orders will be revoked or allowed to expire and companies which have been operating under blanket ratings will be required to apply for priority assistance under PRP. P-98, which, it was expected, would be extended permanently will expire May 15.

The rapidly increasing materials requirements of the war program, Mr. Knowlson explained, make it impracticable to continue the use of preference ratings which have been assigned under existing "P" orders of whole industries without any exact check of the amount of material which such ratings may be used to obtain. Through PRP, Mr. Knowlson will continue to assign ratings to deliveries of materials for essential uses, but the rating assigned in each case may be used to obtain only a specified quantity of materials or products.

Under PRP, a company makes a single application for priority assistance covering all of its estimated material needs over a 3-month period. The applicant must submit full information as to his inventories, the end use of his products, etc. Priority ratings are assigned on the basis of such applications to permit producers of commodities essential to the war effort or minimum civilian needs to obtain specified quantities of materials during a quarter.

Interim applications may be filed when a company needs additional quantities of material during a quarter because of increased war or other essential business.

A modified PRP has been developed to meet the needs of small firms whose business is less than $100,000 a year. Such companies may use a simplified application form PD-25X.

The effect of placing virtually all American industry, including producers who supply the Army and Navy under PRP will be to give WPB closer control of the distribution of scarce materials.

The most important raw materials such as aluminum, copper, steel plates, etc., are already allocated at the producers' level. General use of PRP will provide control of the flow of these materials down to the level of end products.

Because it would be physically impossible to handle the load of PRP applications if they were to be submitted immediately from all companies in all industries, the changeover from the use of blanket ratings will be continuous over a period of 3 months.

A WPB spokesman today indicated that P-98 might have to be extended from its present expiration date of May 15 because the petroleum industry might not be reached before then. He suggested a 30-day extension of the present order might be required.

Processing of PRP applications, it was emphasized, will be handled in cooperation with the industry and OPC in such a way that all companies producing similar products for similar uses will receive uniform treatment.

JOURNAL SURVEY OF OPINION

OIL MEN EXPRESS VIEWS ON CURRENT TOPICS

This is the second of a series of surveys the Journal's editors are conducting to ascertain how oil men are thinking about outstanding developments and proposals of current interest. Queries were addressed to a cross-section of managerial and technical personnel in the operating branches of the industry. The majority of the replies included comments which are summarized in this discussion of the results of the questionnaire.

Solution of Problem of Supplying East Coast

1—Transporting 1,250,000 bbl. of crude oil and products daily from the Gulf Coast to the Atlantic seaboard presents a very difficult war problem. As we all know, it has been brought about by tanker sinkings and the diversion of other tankers to transoceanic service. In your opinion could the East Coast be fully supplied by (a) Convoyed tankers; (b) expansion of inland transportation facilities, i.e., pipe lines, tank cars and barges; (c) or should we accept rationing as inevitable.

Recent events along the Atlantic seaboard appear to have discredited the tanker as a means of supplying domestic demand during a war. Obviously, those replying to the questionnaire did not consider the question relating to supplying the East Coast from the standpoint of profit and loss statements. This was entirely in keeping with the idea behind the question which was a matter of supplying a demand, regardless of cost. More than half of those favoring convoyed tankers consider this solution a temporary one which would fill requirements only until the inland transportation systems had been built up to the point of sufficiency.

Specific recommendations for convoying were few and involved mainly the setting up of safe ports for night "parking" of tankers and increased use of blimps for convoying. It seemed to be generally realized that the Navy necessarily had more important duties in more distant waters.

In this question, it was apparent that many were conditioned by prewar facilities as a greater proportion of replies from Texans favored convoyed tankers than from any other district.

The fact that practically two-thirds of those answering this question considered the extension of inland facilities is evidence of a great increase in "war-mindedness" among oil men. A large percentage of those amplifying their answers with comments showed plainly that they were influenced by the need for tankers and the Navy in foreign waters. Some admitted that building additional tankers would help the situation but considered that other types of vessels were more urgently needed. "Use the Navy for war and not for civilians" was urged by many men.

Those favoring the extension of inland facilities included a number who stated that this was the best answer in peace or in war but the great majority showed that they were considering the question solely from a war angle. Possibly it was this that kept practically everyone from referring to the National Defense line from Texas to the Atlantic and most of those who did mention it commented that it was now too late. Some favored construction of additional lines but only smaller ones to feed individual areas but the great majority considered that coordination of all facilities, pipe line, waterways, and rail, with a minimum of new construction to remove bottlenecks was the answer.

Despite the slowness of barge movement, many thought that use of the Mississippi and Ohio to the fullest possible extent with concentration of new lines and rail facilities from the head of navigation to the market would present the best possibilities.

If a single unified plan could be formed out of the large number of comments submitted, it would be as follows:

1. Determine the maximum capacity of all existing systems to every terminal.
2. Determine the capacity of all outlets from those terminals.
3. If necessary, add to that capacity until the flow of oil along that system could be handled from the field to the market.
4. Take up and re-lay all existing lines which are not used to capacity. The terminals might be river ports or railroad centers.
5. Increase facilities from those terminals in the same way as for existing terminals.
6. Use new steel to increase pipe-line facilities from existing lines to the coast.
7. Ration locally wherever necessary and for as long a period as necessary but consider rationing a temporary and undesirable expedient.

A number of people feel that inland transportation facilities will be adequate when the enforced rationing due to rubber shortage becomes apparent. Transformation of some crude lines to products lines was also suggested as a possible remedy.

In favoring increase of existing inland transportation facilities in disproportionately large numbers, Kansans, Oklahomans, and Louisianans showed their greater familiarity with these methods of transportation.

More than 20 per cent of those expressing an opinion considered rationing inevitable. To this must be added a large number that considered other ways of handling the situation generally satisfactory but considered that some rationing is inevitable. A surprising number considered that rationing was not only inevitable but desirable. Frequently the comment was made that this was war and interruption of our pleasure driving was not the only sacrifice that had to be made. The question of "inevitable shortage" was not raised to any extent and few appeared to feel that rationing would seriously limit our war effort. In fact those who mentioned the connection seemed to consider that if we drove less and worked more it would increase our efficiency.

The large number giving no direct answer to the question of the best way of "fully" supplying the East Coast were not silent because of lack of opinion so much as because they thought that no one way was adequate. Their comments plainly indicated that a combination of all methods that could effectively be used would solve the problem, with comparatively little rationing. Again, the feeling was apparent that the rubber shortage would go far to relieve the oil shortage by reducing demand.

THE QUESTIONS ASKED —AND THE ANSWERS

1—Could the East Coast be fully supplied by

	Per cent
Convoyed tankers?	8.8
Expansion of inland transportation facilities	57.8
Or should we accept rationing as inevitable?	18.9
No answer	14.5

2—How do you regard the plan for pooling equipment now in stock so as to drill new wells through allotment to all operators in proportion to their past activity?

Has unusual merit	19.2
Fair possibilities	22.2
Would gain nothing	15.6
Contains inequities as among companies	18.1
Would be completely foolish	13.7
No answer	11.2

Plan for Pooling Equipment Stock Pile

2—Investigation has revealed that there are sufficient materials carried in inventories to drill 9,000 wells. It has been suggested that M-68 be suspended, permitting these inventories to be used for the drilling of new wells. This would contemplate pooling of present inventories in one common stock pile. Allotments would then be made to operators in proportion to their normal drilling activity. This would carry through approximately 4 to 5 months, permitting companies to retain trained personnel, to complete offset and drilling obligations, and most important of all, to permit the industry to maintain its supplies for the time being. Four months from now the nation's war problems and the oil industry's responsibilities may be in sharper focus. Do you think this plan

(a) Has unusual merit; (b) fair possibilities; (c) would gain nothing; (d) contains inequities as among companies or (e) would be completely foolish.

MANY of those who considered that the plan of pooling equipment now in stock to drill additional wells under suspension of M-68 has unusual merit appeared to have some misgivings with regard to the suspension. At least they regarded some sort of regulation necessary in order that the 9,000 wells would do the greatest amount of work in increasing proven reserves. Some suggested that oils of lesser value should be ignored for the time being in this campaign. Maintenance of trained drilling crews appeared as important as the development of additional oil reserves in the minds of many.

(Continued on Page 72)

STATE CAPITALS...

CALIFORNIA

BECAUSE ADEQUATE SUPPLIES of California fuel oil are of fundamental importance in the conduct of the Pacific war, Wilmington-Long Beach operators were advised last week that the district production committee had voted to make April allocations to the field on a gravity basis.

READ WINTERBURN

Operators appointed a committee with Read Winterburn, chief petroleum engineer, Union Pacific Railroad Co., as chairman, and E. J. Bartosh, G. S. Follansbee, Bruce Robinson, Frank Hardesty, and Emil Kluth as members, to work out problems connected with allocation considerations.

The operators were also asked to furnish data on the ability of Wilmington wells to produce over a sustained period.

E. E. Pyles, chairman of the District 5 production committee, pointed out that while allocations have been made without regard to kinds or qualities of oil, April allocations to Wilmington would consider gravities in order to increase the fuel-oil supply, and asked that operators in the field suggest methods of solving any problems created by the adjustments necessary to accomplish the objective.

The Wilmington field is one of the most complicated, from a geological standpoint, of any field in the state. It is broken up into several producing zones, some of which produce heavy oil; and some light. The production committee's objective is to increase the allocation to heavy oil for its fuel content while decreasing allocations to less-needed light oils.

Mr. Pyles suggested that the Ford zone, which produces light oil but is separate and distinct from other Wilmington zones, might be shut in entirely, which, he said, is also in prospect for other light-oil producing fields.

KENTUCKY

REGULATORY ORDERS necessary in Kentucky to coordinate that state's petroleum affairs with the Interstate Oil Compact Commission's program of research, conservation and prevention of waste will be handled by the Geological Division of the state Department of Mines and Minerals. This procedure was provided by Gov. Keen Johnson who last week signed the compact, making Kentucky the twelfth member of the commission.

It had been necessary to obtain special legislation to give the governor authority to sign the compact. This measure, passed recently by the 1942 Kentucky General Assembly, had been introduced in the house by Rep. D. T. Bolling, an independent operator at Owensboro, Ky., and in the senate by Sen. Lee Gibson, Owensboro attorney. The movement had the backing of the Kentucky Oil and Gas Association and of Kentucky oil operators in general.

KENTUCKY'S GOV. KEEN JOHNSON SIGNS COMPACT . . .

When Gov. Keen Johnson of Kentucky signed a compact aligning Kentucky with other oil-producing states that have joined the I.O.C.C. program, the act was witnessed by five prominent Kentuckians who had backed the measure. Standing, they are: M. A. Arvin, Sen. Lee Gibson, Earl D. Wallace, Rep. D. T. Bolling, and N. W. Shiarella who was appointed Kentucky representative to the compact commission. The commission meets Friday and Saturday in Little Rock, Ark.

ILLINOIS

IN A DECISION which may have a "very persuasive" effect on similar cases now pending before the U. S. Supreme Court, the Illinois Supreme Court on March 18 ruled a deed by which the Eastern Illinois & Peoria Railroad held certain land in Fayette County granted the carrier only an easement on the land for railroad purposes and not a right to underlying oil and gas resources.

The judgment reversed a decision of the Fayette County Circuit Court which held the railroad owned the land.

Plaintiffs in the action were G. L. Tallman, the Carter Oil Co. et al.

The ruling of the state court, oil men believe, will exert considerable influence on deliberations of the U. S. Supreme Court in two similar cases now pending before that body. The suits were brought by the Carter Oil Co., Mr. Tallman, and the Magnolia Petroleum Co.

Walter Davison, of Mattoon, chief counsel for the Carter Oil Co., said "territory affected all is in Illinois, but whatever decision the U. S. Supreme Court reaches in these cases may be a guidepost for later decision on such property in other states."

MISSISSIPPI

THE HOUSE WAYS AND MEANS committee recommended last week that an oil tax of 6 cents per barrel or 6 per cent of value, whichever proved greater, be imposed as a lieu tax for the state's present ad valorem and sales taxes on petroleum. The house bill would be a substitute for a 4 per cent severance tax in addition to present levies proposed by the senate. Gov. Paul Johnson has advocated an average 7 per cent tax on oil.

THE STATE OIL AND GAS BOARD indicated this week that it would make no effort to reduce Mississippi's crude-oil production from its current daily average of 70,000 to 75,000 bbl., which is approximately 30 per cent greater than the April quota of 49,800 bbl. daily certified by the Office of Petroleum Coordinator.

TEXAS

EIGHTEEN SHUTDOWN DAYS for Texas oil producers next month were in prospect this week as the Railroad Commission worked on the problem of trimming crude, natural gasoline and condensate output to an average of not more than 1,134,000 bbl. daily.

The commission's engineering department, it was understood, has recommended 18 shutdown days next month in order to reduce crude production to approximately 1,000,000 bbl. daily. In previous rates of production certified by the OPC, natural-gasoline and condensate yields were excluded. Production of the newly included hydrocarbons amounts to 120,000 or 125,000 bbl. daily. Provision must be made for new production developed during the month in the basic proration order.

The OIL AND GAS JOURNAL

PRODUCING REFINING NATURAL GASOLINE PIPE LINE

Published weekly by The Petroleum Publishing Company at Tulsa, Oklahoma

Needed Legislation

Requests for new legislation and the repeal of several existing laws are pouring into Washington. All are designed to aid this country in its war effort and a public, finally aroused to the fact that many things are going on that shouldn't be, will get what it demands.

But little is heard regarding legislation which, if enacted, would be a major contribution to the oil industry's complete support of all-important production phases of the war program. A simple law is needed which would assure those in charge of management that they would not be prosecuted now or later for doing collectively what everyone agrees needs to be done. The new law would not, in any way, repeal or nullify existing antitrust protection of free enterprise which is part and parcel of this country's economic system. It would, however, permit those in charge of operations to carry out cooperative production and distribution plans, minus the threat of being subjected to criminal proceedings.

The industry at the start of the defense plans was as prepared as any business could be. But new war demands, and changes in operating conditions which could not have been foreseen, have arisen.

The Government wants 100-octane aviation gasoline output boosted to a figure that will be approximately equal to present Axis production of all oils. Petroleum hydrocarbons will replace millions of acres of distant jungle country as the source of rubber supply for the United Nations. A tanker shortage has brought major transportation difficulties. Producers are asked to find new oil and maintain present crude-oil output with less than half of the normal equipment and materials.

As revealed by this publication's recent polls of opinion, the objective of oil operators in the solution of these problems and those that are to come, is to consider them all in the light of winning the war. To this end petroleum leaders are giving the entire nation an outstanding example in industrial statesmanship.

In application of solutions, all branches of the industry are handicapped. Its representatives are advising the war agencies. They are dropping everything else when they are asked to do a specific job.

But action could be expedited if operators were able to cooperate quickly in whatever groupings are necessary in applying remedies. Many problems could be anticipated and solved before they became serious. As it is, there are costly delays, and solutions are becoming more and more difficult. These situations inevitably will lead to a complete breakdown if they continue for a long period.

The Government and oil-industry activities under the NRA of 1933-1935, had much to commend. Operators got together, not only to discuss and advise, but to act. Everything they did was subject to the scrutiny of Washington. The Government wanted action, and got it.

But everybody knows what happened after that emergency was over. The petroleum industry was rewarded for its accomplishments with the Madison prosecutions, an abortion of justice applied to industrial enterprise, the sting of which will continue through this generation. Unfavorable reactions in other industries were general and continue to this day.

Government officials have said this will not happen again. At the same time, they concede they are not sure as to how existing antitrust laws should be interpreted. They agree their acts of immunity are not binding on their successors.

The only answer to this confusion is a new law. This industry and other industries know what is needed. Management has the patriotic duty to secure public support for legislation which will enable oil operators to put both shoulders to the war wheel without fear of judicial reprisals.

Pipe Lines May Help Solve East Coast Supply Problem

By PAUL REED

THE part that pipe-line systems will play in contributing to the solution of the problem of moving petroleum to the East Coast is receiving special attention. With the tanker fleet engaged in Gulf Coast-East Coast shipments recently reduced, according to current reports, from 192 to 127 tankers, the country is now facing the possibility that additional substantial reductions in coastwise shipping may be necessary because of war conditions. Results obtained through tank-car movements have been encouraging. In the week ended March 14 tank-car deliveries were stepped up to another all-time high of 439,200 bbl. daily, against 435,086 bbl. in the previous week but stocks declined another 1,501,000 bbl. in spite of a concurrent drop in the demand for heating oil. Since probably close to 30,000 tank cars are employed in the present movement it has been suggested that the effective use of 40,000 tank cars might make it possible to supply the East at the rate of 600,000 bbl. daily by this method. But operators point out that tank-car transportation is expensive and unsatisfactory except for meeting an emergency. Compared with the East Coast demand, stated by Coordinator Ickes to be 1,700,000 bbl. daily, present pipe-line shipments to the East Coast amounting to less than 70,000 bbl. daily appear to be little more than a trickle.

Seaboard Capacity Small

The capacity of lines shipping crude oil from the Southwest to the Illinois and Indiana area totals more than 635,000 bbl. Lines capable of moving crude eastward from the Illinois-Indiana area as far as Lima, Ohio, have a total capacity of about 380,000 bbl. Although these lines can contribute something to the solution of the problem by making it possible to shorten tank-car trips there is a definite limit to what can be expected of them. This is because they were designed to adequately serve the central states but not the Atlantic seaboard. By making a number of changes in these crude-oil systems for the sake of the present emergency it is conceivable that capacity might be increased from 50,000 to 100,000 bbl. daily into the Lima area but this is far from adequate.

If the national-defense pipe line had been started soon after plans were made for it last summer it could have been built during succeeding months so as to be ready this spring to provide economical transportation of 250,000 to 300,000 bbl. daily at costs comparable to that of transportation in the most efficient types of tankers. Since pipe for a big line from Texas to the New York-Philadelphia areas does not appear to be procurable because of the position taken by WPB, other alternatives are being considered which are less satisfactory but which may be more expedient.

There have been proposals that lines, in Texas and other southwestern states, which are not being fully utilized, might be taken up and relaid. Between East Texas and the Gulf Coast it has been estimated that there is more than 300,000 bbl. of daily idle capacity. The several projects have been discussed for reusing pipe.

One of these is a crude-oil line from Lima, Ohio, to the Pennsylvania boundary. Another is a system for moving crude from East Texas to the Mississippi River to which an extension might be added for transporting West Texas crude. A suggestion has been made that facilities for moving crude by pipe line, north and east from North Texas should be enlarged. A line has been proposed for moving refined products from Gulf Coast refining areas to Baton Rouge, La.

Already steps are being taken to use gasoline lines effectively for the needs of the situation. Attention has been directed to utilizing excess capacity of gasoline pipe lines in the St. Louis and Chicago areas. Shipments by gasoline pipe line destined for export to Canada have increased in recent weeks. Atlantic Refining Co. has reversed flow of the Pittsburgh-Philadelphia pipe line owned by its subsidiary, Keystone Pipe Line Co., to ship westward. Standard Oil Co. of New Jersey is considering the advisability of reversing the flow of the gasoline line of Tuscarora Oil Co., Ltd., and will do so when it is possible to get sufficient supplies at its western terminal. However, if flow was reversed so that all gasoline pipe lines in Pennsylvania shipped eastward not more than 50,000 bbl. daily capacity would be provided.

Tank-car shipments from the Greensboro, N. C., terminal of the Plantation Pipe Line Co. are reported to be going north at the rate of 20,000 bbl. per day.

Several proposals have been made that refined products be moved eastward from the Illinois-Indiana refinery area through certain crude-oil lines which might be converted to this type of service. A change from crude to products transportation might result in an increase of 10 per cent, but it is not regarded as practical. In crude-oil lines the change from winter to summer conditions normally results in an increase of from 10 to 12 per cent in capacity.

Trunk-Line Expansion

Increases in capacity in existing trunk-line systems which might contribute 50,000 to 100,000-bbl. additional capacity to systems shipping northeastward might be obtained in several ways. A joint program for operating parallel lines might utilize excess capacity at different points. Looping offers possibilities. A new method of flow control is now making looping practical for products lines although heretofore it has been regarded as suitable only for crude systems running one grade of oil. It has been estimated that half the engines at pipe-line stations could be speeded up.

Superchargers are hard to get under wartime conditions but experience has demonstrated that with one it is possible to get an increase of 50 per cent in diesel horsepower. Much can be accomplished sometimes by shifting pumping equipment. New equipment is difficult to obtain for intermediate booster stations. But certain makeshifts might serve for an emergency. For instance, slush pumps from drilling rigs whether driven by steam, diesel or gasoline-engine power might be installed to advantage at the low-pressure end of a section of line between pumping stations. Such an installation might make possible an increase in capacity of 20 per cent.

Inland waterways will probably be used more extensively to supplement pipe-line and tank-car transportation.

Without new pipe-line facilities directly connecting Texas with the New York-Philadelphia area, inland transportation facilities will be about 400,000 bbl. short of moving the 1,250,000 bbl. of crude and refined products to the East Coast to meet requirements. With pipe-line movements into the East Coast area possibly raised to 200,000 bbl. daily through future extensions, new lines, and expansion, with tank-car shipments increased to 600,000 bbl. daily and barge movement increased to 50,000 bbl. daily, the total will be only 850,000 bbl.

After all of the alternatives have been considered for meeting the present petroleum transportation dilemma the proposal to lay a crude or a products line or both from Texas to the East Coast stands out as the method which is highly efficient and economical as well as the one with the greatest promise of effectiveness under war conditions.

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Pipe-Line Executives Consider Problems

Pipe-line executives from eastern, Middle West and Gulf Coast areas of the United States met early this week in Tulsa to consider problems affecting deliveries of oil to the Atlantic seaboard states. They are members of the pipe-line subcommittees of the transportation committees of Districts 1, 2 and 3 of the Office of the Petroleum Coordinator.

W. R. Finney, coordinator of production and pipe lines for the Standard Oil Co. (New Jersey), New York, was chairman of the meeting. With him from District 1 was George Hanks, vice president of the Tide Water Associated Oil Co. From District 2 were Clark H. Kountz, pipe-line division, Sinclair Refining Co., and Charles Bunje, president of the Illinois Pipe Line Co., Findlay, Ohio. From District 3, representatives were Bert E. Hull, president, Texas Pipe Line Co., and T. E. Swigart, president, Shell Pipe Line Co.

In addition to these subcommittee members, chief executives of the pipe-line companies operating from the East Coast to the Rocky Mountains participated.

The matter of taking up existing crude-oil and natural-gas pipe lines and relaying them to increase deliveries to the East Coast was one possibility considered. Ways and means of increasing pipe-line capacities and deliveries to relieve the shortage on the Atlantic seaboard, due to sinking of tankers and diversion of others to military service, were considered at the meeting.

Recommendations of the subcommittees will be made to the chairmen of the transportation committee of the three districts who, in turn, will submit them to Petroleum Coordinator Ickes.

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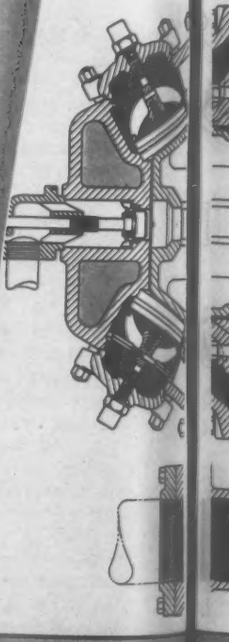

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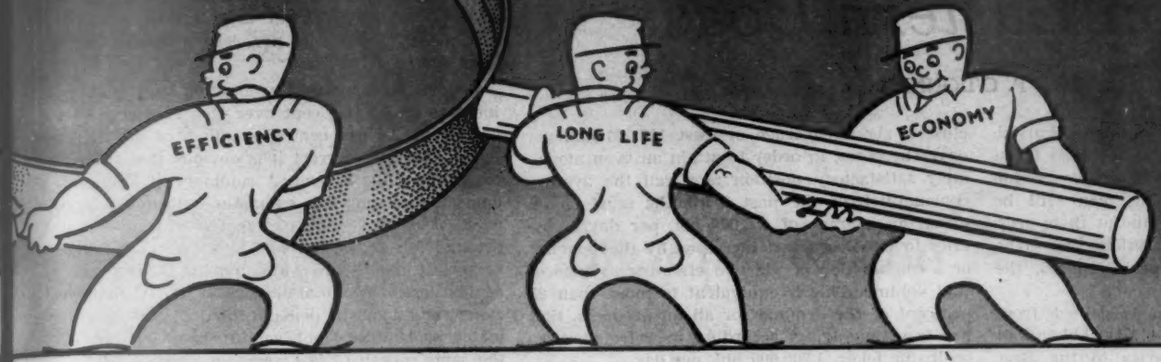

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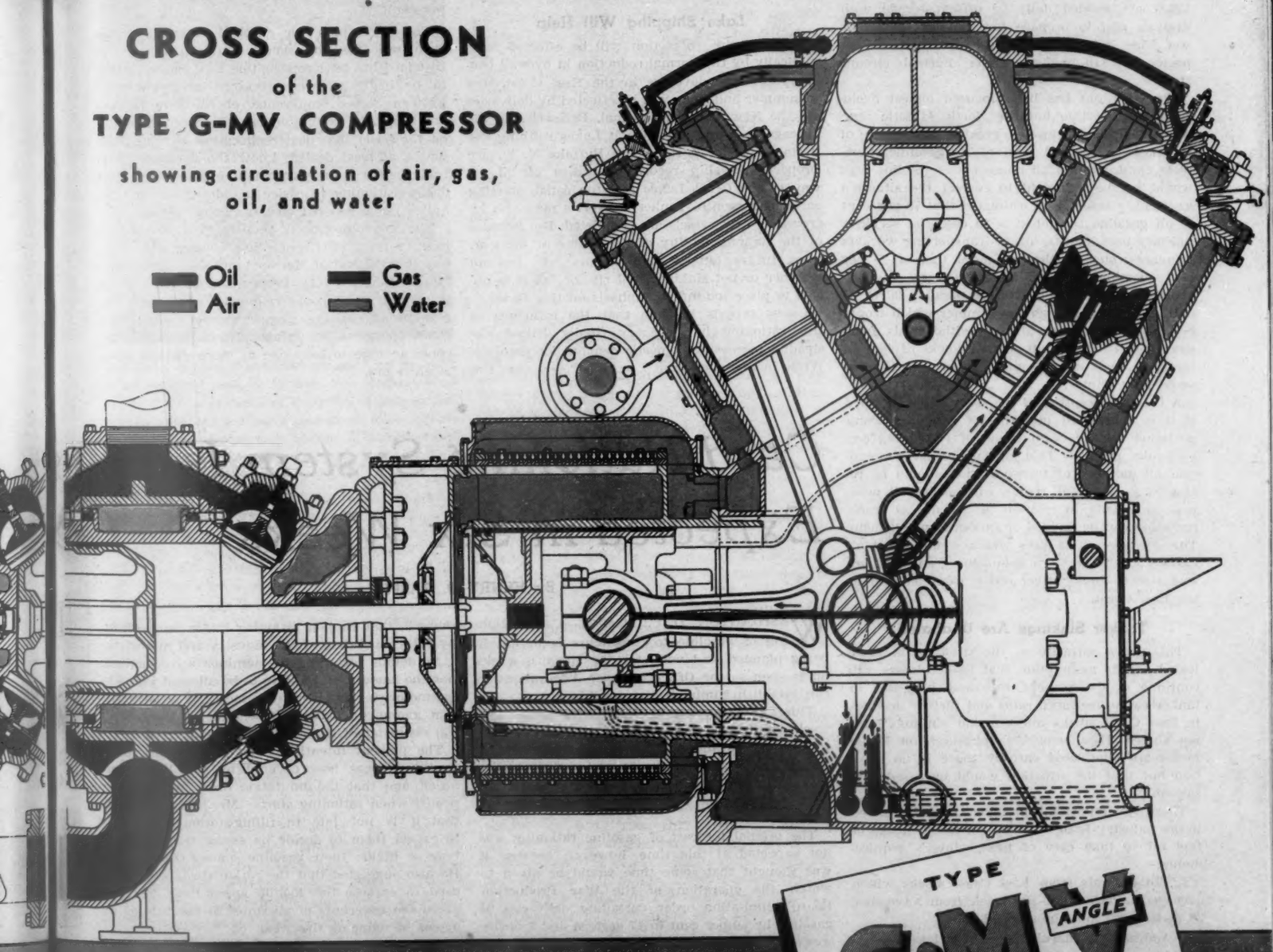

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More Drastic Curtailment Needed on Eastern Coast

By J. P. O'DONNELL

NEW YORK, Mar. 23.—More drastic curtailment of oil consumption on the East Coast than that resulting from rubber conservation and from the gasoline rationing plan will be necessary if tanker losses continue at their present rate and if adequate preparations are to be made for the next period of peak demand, the winter of 1942-43.

Appreciation of the problem is gained from consideration of the fact that 450,000 bbl. of all products above current deliveries to the East Coast are needed daily to offset storage withdrawals and to prepare for the next peak season. This is equivalent to the transportation capacity of 110 tankers under normal circumstances.

The spotlight has been focused almost exclusively on gasoline but the North Atlantic market actually consumes a greater proportion of the nation's fuel oil than of its gasoline. Complete elimination of all nonessential gasoline uses would not be sufficient to correct the situation as it exists today. It is estimated that 75 per cent of all gasoline consumed is in essential services, military uses, trucks, buses, transporting workers to plants, etc., so that no more than a 25 per cent curtailment could be effected by gasoline rationing. This would conserve possibly 30 to 35 million barrels through the summer which would be less than enough to stop withdrawals from storage and to build up enough stocks of fuel oil for industrial, marine and domestic-heating demand next winter.

A better conception of the situation is obtained if it is considered in terms of rationing transportation instead of in terms of restricting any particular product. This indicates, some contend, that all methods of transportation should be realigned so that each region will receive oil products as equally in relation to demand as transportation can be divided or rationed among them. This includes all tankers which would affect all nations in the Western Hemisphere and all tank cars which would affect other areas as well as the East Coast.

Tanker Sinkings Are Unabated

This grave estimate of the situation is predicated on the assumption that tanker losses will continue at the present rate and increases in tanker cargo insurance rates and further declines in East Coast stocks indicate that sinkings have not abated. This factor is emphasized, for if the losses are eliminated entirely there is no question but that the situation would be eased considerably.

These two immediate problems must be solved if the industry is to build up sufficient stocks of fuel oil to take care of next winter's requirements:

1. Withdrawals from East Coast stocks which averaged 2,198,000 bbl. per week from November 29 to March 7 must be stopped.

2. Additions to fuel-oil stocks of at least 25,000,000 bbl. must be made through the next 6 months to prepare for winter requirements.

Withdrawals from storage on the East Coast averaged 314,000 bbl. per day through December, January and February and the first week of March. Minimum additions to fuel-oil stocks through the 6 months, April to September, inclusive, should average at least 137,000 bbl. per day. Therefore, in order to attain an even moderately satisfactory position next fall the average consumption of the past 3 months must be reduced an average of 450,000 bbl. per day, deliveries to the East Coast increased by that amount or a combination of the two effecting savings of that volume. This is equivalent to more than 25 per cent of the demand for all oil products, that has been averaging, according to Petroleum Coordinator Ickes, 1,700,000 bbl. per day.

Lake Shipping Will Help

Some of this correction will be effected automatically by the normal reduction in over-all consumption that develops in the East Coast area in summer and some will be effected by deliveries via the New York barge canal. Refineries in the Chicago area and other Great Lakes refining districts from Lockport, Ill., to Buffalo, N. Y., are prepared to ship record quantities of oil by way of the Great Lakes and the canal, starting early next month. Tanker deliveries may also increase as new vessels are completed. But because of the unpredictability of the course of the war, what future tanker requirements will be and whether or not sinkings will rise or fall it is unsafe to place too much emphasis on this factor.

Latest reports indicate that the influence of tire rationing in February finally halted the steadily increasing domestic demand for gasoline. While increases of from 7 to 16 per cent over the corresponding month of the previous year were reported in every month of 1941 and in January of 1942, domestic consumption of gas in February was approximately the same as in February 1941. A substantial increase in the volume of exports, however, put total gasoline demand last month about 2.35 per cent greater than a year ago.

Reports on domestic consumption vary from an increase of 1.5 per cent over last February to a decline of 2.5 per cent. Regardless of which extreme is nearer correct it is obvious that the era of sizable gains is over. A summary of February domestic consumption estimates indicates a total of 42,000,000 bbl. which compares with an actual demand for 42,253,000 bbl. in February 1941. Exports last month are estimated at 2,650,000 bbl., against last year's total of 1,365,000 bbl. Combined export and domestic demand this February is estimated at 44,650,000 bbl. against 43,618,000 bbl. in the same month of last year, an increase of 2.35 per cent.

The WPB plan for gasoline curtailment has been welcomed by service-station operators in District 1 but later reports that card rationing was to be instituted were received adversely. The Eastern States Conference of Gasoline Dealers has adopted a resolution opposing card rationing on the basis that dealer allocation is more flexible, that local dealers know the needs of their trade better than government officials, and that dealer rationing is easier to administer and requires much less red tape and bookkeeping.

The only objection of retailers to L-70 was the lack of uniformity regarding closing time. The Gasoline Council of Metropolitan New York listed two objections: (1) Proper enforcement of a stagger system would require a large staff for regulation; (2) the stagger system would give chain operators an unfair advantage since they could arrange to have one or more stations open at all hours.

Card Rationing System Is Expected in Six Weeks

By HENRY D. RALPH

WASHINGTON, D. C., Mar. 23.—Card rationing of gasoline to consumers is definitely being planned and will start in about 6 weeks or as soon as the Office of Price Administration can establish administrative machinery.

This announcement by Coordinator Ickes last week confirmed reports which have been current for some time and which were strengthened by the OPA announcement a couple of days earlier that Joel Dean had been appointed chief of gasoline rationing in the newly created Rationing Division.

The official forecast of gasoline rationing was not expected at this time, however, because it was thought that some time would be given to watch the operation of the War Production Board's limitation order curtailing deliveries of gasoline by 20 per cent in 17 eastern and 2 northwestern states, which went into effect the same day Mr. Ickes made the announcement. While the industry committees of the eastern district had recommended curtailment of deliveries as a preliminary step to card rationing, belief that consumer rationing might be delayed was heightened by a statement issued by William R. Boyd, Jr., chairman of the Petroleum Industry War Council, that coupon rationing might be avoided by full cooperation of the industry and motorists.

No details regarding the administrative method nor the amount of gasoline to be allowed individual motorists have been announced. It is assumed that amounts will vary depending on the essential character of the use of the gasoline.

The present intention is to confine rationing to those areas now covered by the limitation order, and that the limitation order will be repealed when rationing starts. Mr. Ickes declared that it is not fair to filling-station operators to expect them to decide on essential needs nor how to divide their gasoline among customers. He also suggested that the ration cards could be used to enforce the 40-mile speed limit he has asked the governors of all states to institute as a means of reducing tire wear.

Country-wide rationing is a distinct possibility, however, and Mr. Ickes said that this would be up to the Office of Price Administration. He declared:

"We haven't felt that we were justified in cutting off the supply of gasoline, even fractionally, in areas where there is plenty of gasoline and plenty of transportation. However,

there is another question which doesn't come within my jurisdiction. There is something to be said for rationing gasoline all over the country in order to save tires. But I am not responsible for the rubber program and I haven't felt justified in going any further than we have gone, namely, rationing gasoline in areas where there was actually such a scarcity of transportation that we couldn't bring in enough gasoline to supply the demand."

The coordinator said that it did not now appear likely that gasoline rationing would be necessary in District 2 (Middle West) because of a supply shortage, even though some 10,000 tank cars have been taken out of this district for use in District 1, and more are being sought.

Mr. Ickes said that stocks of heavy fuel oil in the East Coast area showed a deficiency of 684,000 bbl. on March 14 as compared with March 7. He added that stocks on March 14 were 12,326,000 bbl. below the figure on March 15, 1941.

Joel Dean, appointed gasoline rationing chief by OPA, is an industrial engineer formerly with McKinsey-Wellington & Co., a professor at University of Chicago and later a price and marketing consultant. More recently he was price executive in charge of industrial and agricultural machinery in the OPA

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Tanker Insurance Rates Reflect Fear of Sinkings

NEW YORK, Mar. 24.—Substantial upward revisions in war-risk insurance rates were announced last week by marine underwriters. The bulk of the revisions affected trades outside the Western Hemisphere but virtually all those covering shipments in this hemisphere's waters affected shipments by tankers and tank barges. The changes were significant in that they emphasized the greater danger incident to tanker operation.

The emphasis on tankers was so great that in one instance insurance rates for shipments by other vessels were reduced while in the same route, rates on tanker shipments were advanced. This affected trade between Pacific Coast ports from Canada to Mexico and Atlantic ports of South America south of Paramaribo.

A new rate of $5 per $100 was fixed for tanker cargoes in Atlantic coastwise trade. The previous rate was $4 per $100, making the increase one of 25 per cent. Similar advances were made on shipments from the West Indies to North Atlantic ports and on shipments from the Gulf Coast ports to Canadian Atlantic ports and Newfoundland.

Probably the greatest disparity between rates for tanker cargoes and those for shipments by other vessels was shown in the new rates applicable between Cuba and United States Atlantic and Gulf Coast ports. While the tanker rate jumped from $1 to $2.50 per $100, the rate for other cargoes rose only from 50 cents to $1.

In a subsequent amendment, rates on tanker shipments from United States Atlantic and Gulf ports to Canadian Atlantic and Newfoundland ports was raised to $6 per $100. The War Shipping Board this week approved maximum rates and surcharges for transporting oil products in Caribbean and South Atlantic trades. Application of a 20 per cent surcharge for war-time costs is allowed. This surcharge compares with 37½ per cent allowed on shipments between United States Gulf and Caribbean ports and North Atlantic ports from Miami to Montreal.

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Condensate and Natural Gasoline Included in April Quotas

INCLUSION of condensate and natural gasoline with crude oil in production quotas certified to the various states for April signals a radical departure from previous forecasts of demand by the Bureau of Mines and, more recently, the Office of Petroleum Coordinator. Daily production of petroleum and related hydrocarbons during April of 3,656,000 bbl. was certified by OPC late last week and calls for substantial revisions from March.

The April quota is approximately 135,900 bbl. below the March certification of crude production. However, considering that the country produces more than 200,000 bbl. daily of natural gasoline and that condensate output is more than 60,000 bbl. daily, the actual reduction in crude production will be nearly 400,000 bbl. under the OPC quotas.

Texas and New Mexico were the two states hardest hit by deficiencies in transportation which, during most of March, has been responsible for pipe-line proration, particularly in West Texas where most purchasers are buying from 22.5 to 50 per cent of the Railroad Commission allowable. Texas' quota for April, including crude oil, condensate, and natural-gasoline production, was 1,134,000 bbl. daily compared to the adjusted March figure of 1,338,600 bbl. The April figure, according to analysis by Jerry Sadler, Railroad Commission member, means that crude-oil production must be based on allowables of less than 1,000,000 bbl. daily in order to adjust for inclusion of about 121,300 bbl. daily of natural-gasoline and recycle-condensate output.

The New Mexico quota, also including natural-gasoline production, was set at 86,000 bbl. daily in April, a cut of 14,200 bbl. under the March requirements which applied only to crude. An increase of 31,600 bbl. was assigned Oklahoma but the quota of 436,900 bbl. daily in April includes around 26,000 bbl. of daily natural-gasoline production.

California, the second largest producer of natural gasoline, was assigned a total quota of 659,800 bbl. daily in April compared to authorized output of crude alone in March at the rate of 627,000 bbl. daily. California produces about 38,000 bbl. of natural gasoline daily, indicating that the daily rate of crude withdrawals next month will be about 621,800 bbl. Kansas' crude quota in April is approximately the same as authorized in March. Next month's quota of 253,400 bbl. daily includes more than 7,000 bbl. of daily natural-gasoline production.

"We are broadening the production quota-certification procedure," explained Coordinator Ickes in Washington, D. C., "for the simple reason that the urgencies of the war situation no longer permit the ignoring of what amounts to a substantial portion of the United States production of petroleum liquids. Approximately 5 per cent of total production consists of condensate and natural-gas derivatives. Obviously, inequities cannot help but arise if the recommended rates do not also take into account the production requirements for the other petroleum liquids."

Illinois' production quota was reduced to 354,400 bbl. daily in April, including more than 4,500 bbl. daily natural-gasoline output. The authorized crude-oil output in March was 362,500 bbl. daily. The reduction of 8,100 bbl. in total quota means that crude output must be lowered more than 12,000 bbl. daily.

"The April figures," said the coordinator, "reflected a further necessity of reducing petroleum production rates for various states in the Gulf Coast region.

Eastern Demand Unsatisfied

"The situation which we warned against last summer has now come to pass," he said. "We have reached the point where the pressing demand for petroleum and petroleum products in the eastern consuming centers cannot be entirely satisfied because of the lack of transportation.

"The important producing areas of the Gulf Coast are unable to meet that continuing demand because their outlets are war-obstructed. The effect of this obstructed outlet is apparent in the difference between the national demand for 3,730,000 bbl. of crude oil daily, as forecast by the Bureau of Mines for the month of April, and the actual available outlet for only 3,656,800 bbl. of all petroleum liquids for the same month.

"Such a situation inevitably must result in hardships for both districts: To the East Coast, where restrictions must be imposed because the oil cannot be delivered; and to the producers of the Gulf Coast who will be unable to market the products they otherwise would if sufficient tanker transportation were available."

The daily rate of flow, to be certified to the state regulatory bodies for April, and reflecting both crude, condensate, and natural-gas derivatives, in comparison with the March figures that embraced only crude, is shown in barrels a day:

State—	April	March
Texas	1,134,000	1,338,600
California	659,800	627,000
Oklahoma	436,900	405,300
Illinois	354,400	362,500
Louisiana	313,000	314,700
Kansas	253,400	246,300
Wyoming	88,900	80,500
New Mexico	86,000	100,200
Arkansas	74,000	71,500
Michigan	50,200	49,500
Pennsylvania	49,900	48,200
Mississippi	49,800	53,100
Montana	23,700	21,000
Indiana	18,200	18,000
West Virginia	15,200	9,600
New York	14,600	14,500
Kentucky	12,800	12,000
Ohio	10,100	9,200
Colorado	6,900	6,400
Nebraska	5,000	5,100
Total	3,656,800	3,730,000

Refiners May Be Forced to Increase Fuel-Oil Yields

By H. STANLEY NORMAN

THE most drastic change in refinery operations in a decade is facing the industry. War exigencies dictate curtailment of gasoline production and an increase in fuel-oil recoveries from refining operations.

Strong recommendations have been made to the Office of Petroleum Coordinator calling for a horizontal reduction of 10 per cent in the refinery yield of gasoline. Fuel-oil production, insist those making the representations to OPC, would be increased more than a corresponding 10 per cent because of the elimination of losses which normally accompany reforming operations in converting low boiling distillates, such as kerosene and range oil, to motor naphtha.

Compensatory Prices Necessary

Refiners recognize the necessity and desirability for adjusting operations to the extent that will compensate for lower consumption of gasoline and greater requirements for fuel oils. Delays in implementation of the program are caused by indifference of the Office of Price Administration or by the timidity of the OPC, possibly both. Efforts to obtain a sympathetic audience with OPA on the price adjustments essential to greater production of lower value fuels have been unavailing. The OPA and OPC have failed to make promised adjustments in prices to offset higher transportation charges to the East Coast.

Average production of gasoline by refineries of the United States is 44.1 per cent of the crude charged. Based on the present tank-car price of 63-66-octane motor fuel, selected because of its independence from other market factors such as supplies and prices of tetraethyl lead and natural gasoline, the average refiner recovers 93 cents from this product per barrel of crude run.

Distillate-fuel production averages 13.5 per cent, or 5.7 gal. per bbl. of crude and it sells in the Mid-Continent market at 3.75 cents, netting the refiner 21 cents. Residual-fuel recovery averages 24.5 per cent, or 10.3 gal. per bbl. of crude processed and at the present price of 2.1 cents per gallon nets the refiner about 22 cents.

Gasoline, distillate fuel and residual oils account for more than 82 per cent of the products recovered from a barrel of crude. At the prevailing rates of refinery yields and current prices the three products account for $1.36 of the revenue refiners realize from a barrel of crude.

REFINERY YIELDS AND PRODUCT VALUES

	Per cent yield of crude	Gallons per bbl. of crude	Mid-Continent tank-car price, cents per gal.	Value of products per bbl. of crude
Gasoline*	44.1	18.5	5.00	$0.93
Distillate fuel oil	13.5	5.7	3.75	.21
Residual fuel oil	24.5	10.3	2.10	.22
Total	82.1	34.5	†4.25	$1.36
Hypothetical Results of 10 Per Cent Reduction in Gasoline Yield				
Gasoline*	39.5	16.6	5.00	$0.83
Distillate fuel oil	15.5	6.5	3.84	.25
Residual fuel oil	27.2	11.4	2.37	.28
Total	82.2	34.5	†4.21	$1.36

*Unleaded (63-66 octane). †Average.

RELATION OF GASOLINE, DISTILLATE AND RESIDUAL FUEL YIELDS IN REFINERY OPERATIONS

		—Percentage of yield—		
Months, 1941—	Daily crude runs	Gasoline	Distillate fuel	Residual fuel
January	3,570,000	42.8	15.4	25.3
February	3,587,000	43.3	14.7	25.9
March	3,583,000	43.4	13.8	25.1
April	3,704,000	43.7	13.2	24.6
May	3,853,000	44.2	13.0	23.8
June	3,865,000	44.5	12.7	24.4
July	3,909,000	44.6	13.0	23.6
August	4,018,000	44.0	12.4	24.0
September	4,069,000	44.6	13.2	23.1
October	4,089,000	44.2	13.1	24.3
November	4,051,000	45.2	13.4	24.4
December	4,032,000	45.7	13.7	24.9

Suppression of gasoline production by 10 per cent and increasing the yield of fuel oils by the same proportion simply means that an adjustment in fuel prices must be made to offset the curtailed yield of the high-value gasoline. A hypothetical analysis to the price adjustments that appear necessary to offset the contemplated reversion to greater production of fuel oil is shown in the accompanying tables in relation to the return from existing conditions. The adjusted table is projected on retaining current return from the three chief products and does not take into consideration other factors which may be involved.

The relationship of gasoline, distillate and fuel-oil yields in some of the country's 10 refining districts is fairly constant. In others, particularly the East Coast, Oklahoma and Kansas, inland Texas, Louisiana Gulf Coast and the Rocky Mountains, past records disclose considerable flexibility.

Percentages of gasoline recovered in refinery operations by months during 1941 show variations up to 12.1 per cent in the Rockies between the minimum and maximum recovery of gasoline. A variation of 8.2 per cent between the extremes is shown for inland Texas refineries and 5.5 per cent on the Louisiana Gulf Coast. Monthly averages for the entire country show a less violent fluctuation. The lowest average recovery of gasoline last year occurred in January when motor-fuel yield was 42.8 per cent of the crude charged to stills. The high average was in December when 45.7 per cent of the crude run was converted into gasoline, a maximum variation of 2.9 per cent.

Fuel Yields in Narrow Range

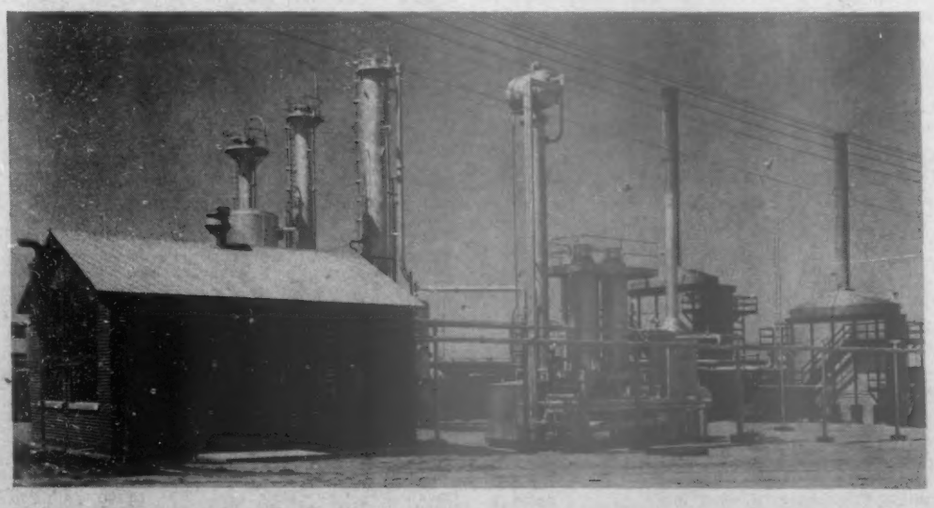
There was a spread of 3 per cent in the distillate fuel-oil production reported last year. The low was in August when 12.4 per cent of crude processed was produced as distillate fuel. The high of 15.4 per cent occurred in January.

A variation of 2.8 per cent in refinery production of residual fuel is shown between the low of 23.1 per cent yield last September against 25.9 per cent in February.

Past records of refinery operations indicate that plant operators have the required processing flexibility if price regulations are adjusted to permit retention of an economic balance.

Another factor, of course, will be the requirements for products needed in prosecution of the war many of which are derived from cracked gases. The most effective method of lowering gasoline yields and increasing production of fuel oils is to reduce cracking operations, particularly in plants that are not direct contributors to war materials.

Any reduction in runs to cracking stills will have a sharp impact on the refinery balance and quality of products in numerous plants, particularly those operators who have installed polymerization units and other facilities dependent upon cracked gases as the raw charging stock. Efficiency of such units, in case they are designed to handle the maximum gas produced in the refinery, will be reduced by whatever rate cracking is retarded.



Adequate charging stock for polymerization plants such as this may become an acute operating problem if cracking is retarded for the purpose of reducing gasoline yields

"Welding saved me $1 on that tankful"

What's the idea of giving me the welding nod every time I buy gasoline?

ALTER EGO: Just because you're searching through today's welding achievements for help in developing a crash-proof business for the future. So, look into the modern oil refineries for a cue.

That's right, they're all-welded so that they can work at higher pressures and thus turn out more gasoline per gallon of crude.

ALTER EGO: To be more specific, they've *doubled* the yield from crude, which cuts costs at the pump 5 cents per gallon. That's how you just saved $1.

Then why couldn't we put that same basic idea to work to boost the quality and cut the cost of our product.

ALTER EGO: We *could* if we *would*. All it takes is the *will* and the *way*. I'll furnish the will. You can get the *way* from The Lincoln Electric Company, Cleveland, Ohio. Drop them a line, state your problem and ask for change-over guidance. There's nothing to lose—everything to gain.

ALTER EGO: Literally, "one's other self"—the still, small voice that questions, inspires and corrects our conscious action.

Many Problems Face Industry In Its All-Out War Efforts

By C. L. HENDERSON
President, Western Petroleum Refiners Association

Here is the president's annual address presented before the St. Louis meeting of the Western Petroleum Refiners Association, March 25. Mr. Henderson is president of Vickers Petroleum Co. Wichita, Kans.

MANY problems face us all in the industry, problems that have a bearing on the efforts that must be put forth in order to help win the war.

The first and foremost problem is to supply 100-octane gasoline, toluene, lubricating oils, and raw materials for synthetic rubber. Of course there are other products, but the most important and pressing at the present time is the supply of 100-octane gasoline. I will not attempt to discuss the problems in connection with these products at this time as they will be dealt with later on in the program by the one man most capable of doing so.

The question of rationing petroleum products has been given much consideration lately; however, the sentiment of the governmental officials as well as the members of industry, seems to have crystallized to the point where rationing will only take place in areas which have a restricted supply. This is sound.

Transportation has been disrupted particularly by the diversion of tankers to military use as well as losses by sinkings, and, therefore, additional burdens have been placed on other transportation facilities. The necessity for tank cars to handle these movements is already familiar to all; however, still greater efficiency must be achieved by all transportation equipment. Crosshauls must be eliminated. The pooling of equipment as well as supplies will in many cases help better to meet the needs. In connection with this, branded names as heretofore known will be of less importance.

Transport trucks will be used for short hauls instead of tank cars. The state regulations governing trucks have already been relaxed by the governors of the various states in order to permit an enlargement of this movement.

The night closing of service stations, the elimination of tin cans for lubricating-oil containers, the restriction on the building of new marketing facilities, the shortage of tetraethyl lead, the securing of needed materials, are all problems that have been and are being dealt with.

The absorption of technically trained men from the industry into the armed forces will require careful scrutiny in order to prevent a disruption to the oil industry's part in the program. Plans should be under way to train men so that the work can go on.

Protection of Property

The protection of plant facilities against damage by sabotage or hostile attacks should receive careful and continuous attention on the part of everyone. The latest help in connection with this is the recent pamphlet issued by the plant protection division of the office of the Under-Secretary of War. This is entitled "Plant Protection for Manufacturers," and a copy of this pamphlet should be in the hands of each company.

Transportation changes, rubber restrictions, and war requirements for products have brought about an unbalanced condition of output and stocks of petroleum products. Careful readjustments must immediately be made in order to prevent what is now almost an economic crisis from becoming more serious.

The unbalanced refinery output which has so far caused a spiraling downward of gasoline prices develops a situation that is being dealt with by the Office of Price Administration. It is in the handling of matters of this kind that the Office of Petroleum Coordinator is very helpful in developing and presenting facts which must be known before corrective action can be taken by the price administrator.

I have mentioned these problems briefly. Some of them we shall discuss, all of them we should ponder.

I am mindful that in the present world crisis every effort, individual, corporate and collective, ought to have a meaning and a purpose inspired by a new sense of duty to America and western civilization and to this and future generations.

The world war presents itself in two aspects. First it is like a comet that threatens us from without; second, it is like a volcano that threatens us from within. We must guard against both the comet and volcano, for either may destroy us.

Interference Tolerated When Necessary

Some day the world may be sold for taxes, and then there will be the devil to pay; but we shall not begrudge the lavish expenditure of goods and money or the consequent burden of taxes for the purpose of defending our way of life against foreign foes, without or within. However, we should have the courage to insist that this war be fought to preserve our way of life, and not to revolutionize and transform it into a fool's paradise.

We cheerfully yield to governmental interference with the most intimate relations of private, professional, and commercial life, if necessary; but this should be conceded with the understanding that these are temporary war powers and not precedents for the invasion of liberty after victory is won and peace returned.

The petroleum coordinator recently stated that he had no desire to take over the oil business and that the control which he was exercising and expected to exercise in the future would be limited to the duration of the emergency. He further stated that it would be his effort to handle his job so that the competitive position of no one in the industry would be changed as a result of this emergency activity.

I have attended every meeting of the Petroleum Industry War Council since it was organized in early December. I have the highest praise for the very fine work which is being done by the petroleum coordinator and his staff. He has gathered around him many men from the petroleum industry, men capable of ascertaining facts and then making sound recommendations based upon these facts. The coordination between the industry committees, the Petroleum Industry War Council, and the coordinator's office is of a very high order and the coordinator's office also is of great assistance to the industry in its contacts with other governmental bodies.

I would like particularly to call attention to the report made by the Petroleum Industry War Council's committee on petroleum economics under date of March 2, 1942. This is a most constructive piece of work and I commend it to you for very careful reading.

Industry Cheerfully Cooperating

The work of the industry committees and the council is being cheerfully and thoroughly performed under the belief that the solemn assurances of the petroleum coordinator as to his intentions in regard to the industry were sincere and would not be forgotten and retracted at some future date.

With this assurance on his part, we, in the industry can do no less than put our shoulders to the wheel, even though it is a wheel without a tire. But we are willing to take the bumps to preserve our democracy.

Now democracy implies not merely the right of the Government to control the people, nor merely the right of the people to control the Government, but also the right of the people to control themselves, individually. The more power a government has, the less liberty the individual has; the less power a government has, the more liberty the individual has.

The appetite for power grows by what it feeds on. Granted, the regimentation of the country is justified by war, and every man must be a soldier of the common good and willing to share the common lot. But when the war is over, the experimental regimentation of the people in time of peace, under the pretext of endless crises, should stop—must stop if we are to enjoy the American way of life.

And right here it might not be amiss to digress and remind ourselves that the much so-called American way of life was made possible in the beginning not only by patriots but by profits. It was won not only by soldiers and sailors and governmental servants of the people, but by the people themselves. Not the least of these was the business man, small and large, the business man who gloried in the respect accorded him as captain of the ship of his own organization, the general who marshaled the forces of men in his employ, furnishing to them the opportunity to earn a living and keep their self respect. And down to the smallest business man, each one was honored for investing the proud profits of his business in enlarged plants and equipment, making

more jobs, that more men might enjoy that priceless privilege.

Let us not forget that profits are honorable, but remember that it is also honorable to forego them if necessary.

I would have no patience with this kind of talk coming from any man who thought only of himself and his property. At this hour I would have no patience with any kind of criticism not unselfishly inspired solely by love of country and all it stands for in the eyes of history.

But we have the right to invoke the example of the English Parliament in which the right of dissent and criticism at all times, in war or in peace, is freely accorded and respected.

James Russell Lowell once wrote:

"I honor the man who is willing to sink
Half his present repute for the freedom to think;
And when he has thought, be his case strong or weak,
Will risk t'other half for the freedom to speak."

That is what has been destroyed in totalitarian countries, and that it what we are fighting to preserve in the United States. In order to preserve it, we must remember that this is a government of laws and not of men. For the people cannot directly administer their government, individually or collectively; they can only indirectly govern through a representative system of laws which define and guarantee the limits of liberty and authority alike. Democracy, therefore, is not so much the rule of the people as it is the law of the people. Under a government of men, nobody knows what the law is and chaos reigns. Germany has a government of men, and Hitler, "like Cato, gives his little senate laws and sits attentive to his own applause."

●

House Hearing Opponents of Cut in Depletion Allowance

WASHINGTON, D. C., Mar. 23.—Strong protests against the Treasury proposal to eliminate the percentage depletion allowance for oil production were made by industry witnesses before the House ways and means committee today, and questioning by committee members indicated that a large bloc, if not a majority, oppose change in the tax law.

First witnesses represented the newly formed general depletion committee. Presentation was opened by former Senator Gore of Oklahoma, who said he was a member of the finance committee in 1918 when the depletion allowance was devised as a war measure and that it has worked well during peace to encourage discovery and preserve existing wells, and should not be abolished during this war. Elimination would destroy the entire economic structure of the oil-producing industry and yield only enough taxes to run the Government 16 hours, he declared.

Mr. Gore said most stripper wells would be put out of business since the depletion allowance is the difference between life and death for them, and also that there would be almost no wildcatting without the allowance.

Additional arguments were presented by B. A. Hardey, chairman of the Louisiana State Minerals Board, and H. B. Fell, Ardmore, Okla., independent producer, appearing as vice president of the Independent Petroleum Association of America and of the National Stripper Well Association and for the OPC District 2 production committee.

Robert E. Allen, assistant deputy petroleum coordinator, told the committee that change would be inimical to the program of OPC.

Statements against change were submitted by George C. Gibbons, W. H. Geis, and D. W. Forbes of Republic National Bank of Dallas, Tex.

●

Oil Shippers Submit Data on Harm of Rail-Rate Increase

WASHINGTON, D. C., Mar. 24.—Economic and other problems caused by the recent 6 per cent increase in freight rates on petroleum products, granted by the ICC over the protest of the OPA, were discussed at a meeting here today of marketers and shippers in District 1.

Joseph H. Salmon, chief of the OPA petroleum unit, opened the meeting by explaining that the OPA is contesting the effectiveness of the rate increase, and asked for data on the economic effects upon the industry of higher freight charges.

Jacob Blaustein, of the District 1 marketing committee, explained that the effect of rate increases in the past has been to force the addition to the selling price of an amount per gallon from the terminal point to the destination point equal, or as nearly equal as possible, to the rate increase, and varied with respect to individual products.

Questioned concerning the effect upon truck, pipe-line, and other transportation rates for petroleum, if pricewise relief is granted on the rail situation, Mr. Blaustein stated that he did not think that there would be any appreciable effect.

"I think for your purposes, if I may say so," he explained, "that it would be well to use the rail rate as a barometer. If you try to get off into all the other sorts of rates, like truck-transport rates, you get yourself involved in a great many other mechanics and problems," he warned.

It was pointed out by W. Hartmann, vice president of the Gulf Oil Corp., Pittsburgh, Pa., that transportation is in a "matter of transition" right now. More and more products are being handled by truck, he said, in an endeavor to release every possible tank car. He added that the east-west movement of petroleum products is "coming more and more to a stop and the oil is coming from west, east."

I. L. Kittinger warned that if any attempt is made by OPA to equalize all factors and marketing practices in connection with the price structure it is bound to "end in utter confusion." He suggested that the OPA allow prices for major products to reflect as nearly as possible any general freight increases.

All of the industry representatives agreed that the ceiling should be raised on all products, rather than to allocate the total increase in permitted price to one, two, or three of the major products.

Marketers and shippers in the other four districts met Thursday and Friday in St. Louis.

●

OPC Moves to Hasten Action On Pleas for M-68 Exceptions

WASHINGTON, D. C., Mar. 23.—Decisions on applications for exceptions to Conservation Order M-68 may be given more promptly in the future. OPC today adopted a change in the procedure for filing applications, instructing operators to file a fourth copy of the Forms 214-a, 214-b, or 214-c, whichever applies, with the director of the district in which the lease, field, or plant is located.

Maritime Commission Contracts For 26 Additional Tankers

WASHINGTON, D. C., Mar. 23.—The Maritime Commission today announced award of contracts for construction of 26 additional tankers, 14 of the Cimarron type and 12 coastal type.

The 14 Cimarron type, one of the largest and fastest tankers afloat, will be built by Bethlehem Steel Co. in its yard at Sparrows Point, Md. The Maritime Commission has awarded contracts for 181 of the large types of tankers since it launched its emergency shipbuilding program a year ago.

Retail-Gasoline Prices Frozen in Curtailed States

WASHINGTON, D. C., Mar. 23.—Service-station prices for gasoline in 19 states along the Atlantic seaboard and in the Pacific Northwest, where tanker sinkings have necessitated curtailment in deliveries to retail outlets, are "frozen" at the levels of March 13, in an emergency order issued last week by the Office of Price Administration.

The order—a 60-day "temporary maximum-price regulation"—became effective March 23.

The OPA, in issuing its "ceiling" order, laid down the following rules for service-station operations in the "curtailment area":

1. No price may be charged for any grade of motor fuel that is higher than the price that was posted for the same grade at the close of business, or at 11 p.m., on March 13, 1942.

2. If, for some reason, there was no posted price on that date, then the service station cannot charge more than the price at which it made its last sale of a similar grade of motor fuel during the 60 days prior to March 13, 1942.

3. In the event a service station has begun operations since March 13, 1942, it may establish temporary maximum prices not higher than those of other operators in the locality. In these cases, however, the temporary prices must be submitted to OPA within 10 days for approval.

4. The maximum price for each grade of gasoline sold at the station must be posted conspicuously in letters at least 5 in. tall.

New Tanker Board Appointed

WASHINGTON, D. C., Mar. 24.—Petroleum Coordinator Ickes has ordered the Tanker Control Board abolished and its work transferred to a new coordinating board. Ralph K. Davies is chairman and other members are B. B. Jennings of Maritime Commission; Comdr. W. M. Callaghan of the Navy; E. Holman, J. R. Parten, and a member to be named from District 5.

Journal Survey of Opinion

(Continued from Page 59)

Those who consider that the plan has "fair possibilities" are divided into some rather large groups. Many feel that by the time the 9,000 wells have been drilled, the air will be clearer, the industry will know what is needed and will be able to get the equipment to go after it. A number feel that M-68 has many good points and some even objected to dropping it, which, of course, would maintain the status quo as operators drilling according to the provisions of M-68 get the equipment now. More in this group considered the wildcatter than in the first group. It was pointed out that the wildcatter was probably not in a position to have any equipment stored and under this arrangement, he could get it. Of course, he can get it now if he wants to drill under M-68. One man pointed out that drilling was by no means the only problem and that if the wells were drilled, there would not be sufficient equipment available to produce the oil.

More support of M-68 comes from the group who consider that the pooling plan would gain nothing. Many of these men consider that the whole drilling problem could be solved by the granting of more exceptions. There is no shortage of oil now or in the near future in the minds of many and to add to the present supply would only complicate the transportation problem further. A number favor the restriction of drilling activity even if the equipment is pooled while some stress the need of getting equipment to the wildcatter and of cutting down on field development. The largest group, however, feel that there is no point in drilling wells until the equipment is all gone and then being unable to do anything. They feel that an adequate stock should be kept.

Although many in the three groups discussed above referred to the inadvisability of penalizing companies with sufficient foresight to lay in a stock of equipment, this argument naturally bulked largest with those who considered that the pooling plan would contain inequities. However, a large proportion of these consider that M-68 is based on sound principles and do not favor departure from it. The idea was expressed by several men that drilling the 9,000 wells now would merely postpone the time when Government and industry would have to tackle the problem of war economy as applied to oil.

The same ideas were expressed by those who thought the pooling plan foolish except that greater stress was laid on the predicament of the industry after the stock pile was used up. Several men pointed out that the stock would last longer than 4 or 5 months for the reason that it would take that long to make the inventory and pool the equipment. In the meantime, it would, of course, be frozen.

Attempting to synthesize all of the different comments on this question into a single statement is, of course, impossible as there are many divergent views. The consensus might be expressed as follows:

(*a*) M-68 is a good regulation and 40-acre spacing is desirable in most cases. More exceptions are needed in areas where the granting of exceptions would do most good both in increasing production and helping the transportation problem.

(*b*) The idea of "business as usual" must be forgotten and everything must be directed to the national interest.

(*c*) The equipment stock pile is a monument to the foresight of at least some operators and should not be dissipated. Its purpose was to cushion the industry in case of an emergency and there is no production emergency now.

DEATHS

W. L. CHILDS, 59, vice president and general manager of Reed Roller Bit Co., Houston, Tex., died suddenly Monday, March 23, from a heart attack. Mr. Childs was born at Union Grove, Ill. He went to Texas in 1905, and worked for the Southern Pacific Railroad until 1907, when he joined Gulf Pipe Line Co. as purchasing agent. He was made secretary-treasurer of Hughes Tool Co. in 1917, resigning 4 years later to go into business for himself. He was named in 1925 to the position he held at the time of his death. Mr. Childs is a former president of the Houston Chamber of Commerce, and when he died he was director of the Petroleum Equipment Suppliers' Association, an organization he previously served as president. He has held numerous other civic and business honors.

H. S. JONES, 50, Fort Worth, Tex., oil man, was killed in an airplane crash in Brazil March 16. Navigator, pilot, radio operator and veteran of the first World War, Mr. Jones had spent much of his life in Mexico, where he was employed by an oil company at Tampico. He went to Fort Worth in 1928, where he organized the now dissolved Midland Oil Co. and later the Midland Investment Corp.

CHARLES W. CHANDLER, 54, former purchasing agent for the Pacific Coast division of the Texas Co., died last week from injuries received in an automobile accident. His home was in Alhambra, Calif., where he is survived by his widow and two daughters.

THOMAS G. TAYLOR, 43, district engineer of the Oil and Leasing Division of the U.S.G.S., Roswell, N. M., was killed in an automobile accident near Roswell on February 25. He had been with U.S.G.S. since 1927, and had been in Roswell since 1929, with the exception of two short intervals during which he was assigned to duties in Washington, D. C. His widow and a son survive.

JOSEPH EDWARD BURKE, 60, independent operator of Tulsa, died last Saturday at his home following a 2-year illness. Mr. Burke came to Tulsa 26 years ago and was for a time associated with the Texas Co. He later became an independent, dividing his time and activities between Oklahoma and Texas. His widow, two daughters and a son survive.

CHARLES P. GREGORY, 66, formerly a salesman for Oil Well Supply Co. in Oil City, Pa., and later manager of the Pittsburgh, Pa., district for Bessemer Gas Engine Co., died at his home in Beaver, Pa., March 13. Death was sudden and resulted from c cerebral hemorrhage.

WILLIAM E. RUNKLE, 85, retired employe of United Natural Gas Co., died in an Oil City, Pa., hospital last week from injuries received sustained from a fall at his home. One son survives.

THE MARKETS*

CRUDE OIL: Pipe-line proration in several southwestern fields, reducing purchases by amounts ranging down to 22.5 per cent of state allowables is softening the price structure. A break is prevented by indifference of all purchasers to an increase in their purchases as long as transportation blockades continue. OPA denied plea of Panhandle interests for an upward adjustment in crude prices for that area.

REFINERY PRODUCTS: Motor fuel is soft in most sections of the country outside of East Coast. All grades of fuel oil are in firm demand and moving at brisk rates from refining centers to industrial and agricultural centers.

TANK-WAGON AND POSTED DEALER: No changes reported in this phase of product markets. Retail prices frozen by OPA in the 19 curtailed states and the District of Columbia.

FINANCIAL: Oil securities traded over a narrow range without feature. Average of 30 representative stocks for week ended March 21: High, 20.75; low, 19.63; close, 20.36. Week ended March 14: High, 20.77; low, 19.78; close, 19.95.

*Detailed information in the Market Section.

Panhandle A.P.I. Attracts 600

PAMPA, Tex., Mar. 23.—About 600 members of Panhandle chapter of the A.P.I. attended the regular monthly meeting of the organization here last week to hear an address by Dr. Ira Williams, Huber Corp., Borger, on the rubber situation and to view a movie presented by Don Heep, TWA representative of Amarillo.

Dr. Williams reviewed the present rubber situation and pointed out that the United States was forced into the manufacture of synthetic rubber for military purposes when the supply from the Far East was cut off. The average consumer does not need to worry about the quality of the synthetics as he will not be permitted to purchase any, the speaker pointed out. Motorists will have to get along on present tires for the next 4 years, according to Dr. Williams. He then explained how synthetic rubber was made and told of the materials needed and difficulty of obtaining many of them.

Participating in the meeting were: Don Heep, Amarillo, T.W.A. representative; Dr. Ira Williams, director of research, Huber Corp.; R. T. McNally, Pampa, superintendent of production, Shell Oil Co., Inc.; Bob Huff, director of the Panhandle office, Texas Railroad Commission; George Berlin, Skelly Oil Co., chairman of the Panhandle A.P.I. chapter; and R. B. Saxe, Pampa, Gulf Oil Corp.

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"LIGHTNIN" Quick Blenders have proved in companies from the largest to the smallest that they drastically reduce blending time (from 1/4 to 1/40 of previous time, depending on the horsepower used). This permits you to save tanks, reduce power consumption, eliminate hold-over of tankers and tank cars, save delays and reduce pumping costs. You can materially step up output without adding a single blending tank. Installations now in use on tanks up to 5,000,000 gallons in size.

Good deliveries are possible now for A-10 priorities. Let's start now so that you will be prepared to meet emergencies when they arise—recommendation and quotation by return mail. Every installation "job" guaranteed. As originators and world's largest producer of quick blending mixers, *"LIGHTNIN"* guarantees every installation—to deliver the goods at the price quoted and in the time stated. MIXING EQUIPMENT COMPANY, 1074 Garson Ave., Rochester, N. Y.

REFINERY APPLICATIONS OF "LIGHTNIN" MIXERS

This chart (1) enables you to visualize quickly important time-saving applications of "LIGHTNIN" Mixers and (2) provides a check sheet for your next recommendations.

PORTABLES ½ to 10 H. P. — FOR RIM ATTACHED OPEN TANKS

TRIPODS ¼ to 15 H. P. — FOR VERTICAL USE ON PRESSURE VESSELS

SIDE ENTERING ½ to 25 H. P. — HORIZONTAL USE— ANY SIZE TANKS

	PORTABLES	TRIPODS	SIDE ENTERING
FUEL OIL BLENDING	Applicable, but usually blended in large batches.	Applicable, but side entering unit usually preferred.	Especially recommended for No. 1, No. 2, No. 3, No. 4, Also Diesel fuels. For any size tank.
LUBE OIL BLENDING	For short orders, small bulk plants, marketers, special jobs, etc. Use on any container, up to 10,000 gal. tank.	Used for lube oil treating or permanent mounting on small lube blending tanks to 10,000 gal.	Insures uniform viscosity. Insures distribution of wax inhibitors. Saves horsepower, time and laboratory tests.
DOCTOR TREATING, CAUSTIC TREATING		Mixer is used in small tank giving short retention period on continuous operation. Longer life for submersion, less cost.	Gasolines requiring only light doctor can be batch treated in large tanks with interesting savings in power.
CHARGING STOCKS		Not applicable. Send coupon for Bulletin B-66 describing Top Entering Mixers.	Give your cracking still operator a uniform charging stock and get higher yield, less coking.
LIMING RE-RUN STOCKS	Liming sour re-run stocks saves expensive tube replacement due to corrosion. Use any tank.		
SPECIALTIES	Blend anti-freeze, windshield cleaner, insecticide, wax polishes, etc.	Use this style unit on synthetic rubber pilot plant, work on hydrogenation, nitration, etc. Inflammable specialties, etc.	Not applicable. Send coupon for Bulletin B-66, describing Side Entering Mixers.

Please send me items checked below:

- ..... Catalog B-66—Side Entering Mixers—for large tanks.
- ..... Catalog B-67—Laboratory Mixers.
- ..... Catalog B-68—Pressure Vessel Mixers—continuous or batch.
- ..... Catalog B-69—Air Driven Mixers.
- ..... Catalog B-65—Portable (Clamp-on) Mixers.
- ..... Operation Data Sheet Mi-11—The basis for a time-saving recommendation.
- ..... COMPLETE CATALOG BINDER—Contains all above Bulletins and much additional information, installation photos, engineering data, etc. For executives and engineers in authority.

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To promote the prosperity of refiners large and small has been the welcome job of Universal for more than 20 years U. O. P. licensees know how we have done that job

Now our compelling motive is to help all refiners both large and small to help win the war

To do that *must* job all U.O.P. processes are at the service of every refiner who can use them—under license from Universal

Those processes make the products that Uncle Sam needs in biggest volume and right now—constituents of 100 octane gasoline and synthetic rubber—toluene for TNT

And the "know how" of Universal's veteran refining specialists goes with them—to make them work their best.

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THE REFINERS INSTITUTE OF PETROLEUM TECHNOLOGY

International

Eastern Venezuelan Fields Raise Production; Lake Area Declines

AN increase of more than 6,000 bbl. in the daily production from fields in eastern Venezuela during January was nullified by a decline of 42,119 bbl. in the average yield from Lake Maracaibo pools. Consequently, crude output from South America's largest oil-producing country receded from its all-time peak of 734,989 bbl. daily in December to 699,072 bbl. daily in January.

Lagunillas relinquished first place as the largest field in the Lake Maracaibo district in January to Tia Juana, Lagunillas' production in January declined to 5,433,860 bbl., a reduction of 1,102,025 bbl. from the December output. Tia Juana also declined but at a much more moderate rate than shown for Lagunillas. Lake fields produced 439,139 bbl. daily in January compared to 481,258 bbl. daily in December. However, the substantially improved demand for Venezuelan oil during the latter part of 1941 and for the first month this year is shown by comparing production of 294,825 bbl. daily from lake fields during the first month last year with the current rate of output.

Increased production from the newer fields in the eastern part of the country contributed substantially to the higher rate of yield from that portion of the country in January. Santa Rosa's production more than tripled, Santa Barbara's more than doubled and one field, Mulata, made its first appearance among shipping areas. Anaco, another new field which is about 25 miles north of San Joaquin, El Roble, Guario and Santa Ana, produced 805 bbl. in January compared to 10 bbl. for the entire month of December.

Other eastern Venezuela fields showing increases in January were La Paz, Mene Grande, Mara, Quiriquire, Oficina, Jusepin, El Roble, Leona and Guario. The Leona field, about 50 miles east of Oficina and originally called El Tigre, has been given pipe-line outlet by construction of a branch to the 16-in. trunk running north to Puerto la Cruze. Leona produced 42,820 bbl. in January compared to 12,140 bbl. in December.

The new Standard Oil Co. of Venezuela Mulata field is west of Compania Consolidada de Petroleo's Santa Barbara field. Orinoco Oil Co. opened production in western Venezuela, about 40 miles northwest of Lake Maracaibo. The company reported production in January totaling 5,350 bbl.

VENEZUELAN CRUDE-OIL PRODUCTION

(By fields)

	Figures in barrels		
	January 1941	December 1941	January 1942
Cabimas	1,259,700	2,119,465	2,118,435
Lagunillas	4,856,790	6,535,885	5,433,860
Tia Juana	2,950,785	5,832,480	5,584,625
Bachaquero	72,305	431,165	476,390
Total Lake fields	9,139,580	14,918,995	13,613,310
Daily average	294,825	481,258	439,139
La Concepcion	57,445	107,810	107,085
La Paz	42,475	30,560	36,290
Mene Grande	935,605	1,220,860	1,230,045
El Cubo	426,440	624,285	616,255
Cumarebo	33,990	177,270	171,005
Las Palmas	2,535	2,165	1,600
El Mene de Mauroa	19,325	18,285	17,755
Hombre Pintado	50,165	41,085	39,560
Mara district	.....	910	5,350
Quiriquire	1,703,310	1,667,540	1,707,690
Pedernales	137,900	129,095	127,030
Temblador	323,025	270,580	266,285
Oficina	1,740,385	2,095,780	2,105,470
Jusepin	337,825	950,700	1,042,600
Santa Ana	715	17,090	17,000
San Joaquin	135,255	289,575	266,515
El Roble	77,395	178,590	183,990
Leona	1,680	12,140	42,820
Guario	6,810	7,280	10,255
Socororo	810	.....	.....
Santa Rosa	1,965	16,810	53,720
Santa Barbara	.....	3,075	6,415
Mulata	.....	.....	2,385
Los Caritos	.....	4,115	.....
Anaco	.....	10	805
Total other fields	6,035,025	7,865,670	8,057,925
Daily average	194,678	253,731	259,933
Grand total	15,174,605	22,784,665	21,671,235
Daily average	489,503	734,989	699,072

(By Companies)

Caribbean Petroleum Co.	935,605	1,220,860	1,230,045
Venezuela Oil Concessions, Ltd.	3,071,475	5,471,370	5,254,560
Colon Development Co.	426,440	624,285	616,255
Lago Petroleum Corp.	4,462,320	8,074,160	7,001,745
Mene Grande Oil Co.	3,682,325	3,911,905	3,963,625
British Controlled Oilfields, Ltd.	19,325	18,285	17,755
Central Area Exploitation Co.	50,165	41,080	39,560
Standard Oil Co. of Venezuela	2,499,555	3,393,005	3,508,945
Compania de Petroleo Lago	22,585	14,325	15,920
Socony Vacuum Oil Co.	6,810	7,295	11,060
Compania Consolidada Petroleo	.....	3,070	6,415
Orinoco Oil Co.	.....	910	5,350
Texas Co. (Venezuela), Ltd.	.....	4,115	.....
Total by companies	15,176,605	22,784,665	21,671,235

Costa Rica . .

Government Offering Public Land for Oil Exploration

THE Costa Rican Government has decided to invite oil development by offering the privilege of drilling on national lands, in the Atlantic Coast Province of Limon. The government's offer of lands at public bidding must be acted upon not later than 2 p.m., March 31.

The exact terms are as follows:

1. Within 3 months of the publication in the Official Gazette of the law approving the contract, the contractor will select for exploration and exploitation, in one single lot, up to 1,000 hectares, and submit the corresponding plan or plans and other details of its location to the minister of public works.

2. Within 12 months of the delivery of the plans, the contractor will explore the selected lot and carry out all necessary drillings, in an efficient and uninterrupted manner, in search of petroleum and other hydrocarbons on a commercial scale.

3. The contractor will pay the state, during the first 15 days of the above-mentioned 12 months, the agreed sum of money which he has offered in his bid for the rights of exploration on the selected lot for the indicated period.

4. If the contractor fails to locate his lot within the 3 months allowed for this purpose, or fails to pay on time the agreed fee for the exploration rights, or if he fails to find petroleum in commercial quantity during the 12 months allowed for exploration and drilling, the executive power will declare the contract cancelled, without any right to compensation on the part of the contractor.

5. If the contractor finds petroleum in commercial quantity during the said 12 months, he automatically acquires the right to exploit this natural resource and other hydrocarbons for the following 25 years, during which period he will continue to explore and drill, on his selected lot, in order to maintain the production on a commercial scale.

6. The company engaged in the exploitation of these natural resources will be considered a public utility, and will be exempt from payment of customs duties on the importation of all machinery and accessories needed, also on the exportation of its products, for the period of the contract.

7. The contractor will guarantee to the satisfaction of the executive power his faithful fulfillment of the contract, and undertakes that in the work of exploration and exploitation, he will employ Costa Rican engineers and workmen as far as possible.

8. The contractor will pay the state as royalty, 15 per cent of the gross value of all petroleum and other hydrocarbons which he produces, of which 13 per cent will pertain to the national government and 2 per cent to the municipalities of Limon Province in a proportion to be determined by the executive power.

9. The obligations of the contractor are not to be interrupted in any manner. The contract may not be transferred to others without the consent of the executive power and in no case to a foreign government. Any differences which may arise between the government and the contractor, in the execution of the contract, during the periods of exploration and exploitation, shall be resolved by arbitrators appointed by themselves. In no circumstances shall the contractor resort to diplomatic intervention and the mere fact of his so doing shall be sufficient reason for the cancellation of the contract, without any responsibility on the part of the government.

10. The state reserves the right to reject any or all propositions, or to accept any proposition which offers better terms than those stipulated above.

11. The contract to be made between the government and the contractor will not be valid without the approval of the National Congress.

Dutch East Indies . .

Destruction of Fields Reported Thorough Job

OIL men who have returned from the Netherlands East Indies report that a "good job" was done in destroying the Standard-Vacuum refinery at Soengei Gerong. Press reports to the effect that communications have been reestablished with Medan in northern Sumatra may indicate that the Japanese have not yet reached the oil fields in that area nor the Standard-Vacuum refinery at Pangkalan-Brandon.

Natural Gas News

Gas-Export Application To Be Considered April 6

WASHINGTON, D. C.—The Federal Power Commission has called a hearing for 9:45 a.m., April 6, on the application by the Border Pipe Line Co., Houston, Tex., seeking authority to export natural gas from the San Salvador field in Hidalgo County, Texas, for use by the American Smelting & Refining Co. in its zinc smelter at Rosita, Mexico. The hearing will be held in Room 416, Court of Appeals, U. S. Courthouse, Fort Worth, Tex. The order states that interested state commissions may participate in the hearing.

According to the application, the zinc producing company's gas requirements are estimated to be 10,000,000 cu. ft. of gas per day which would be sold, under a contract between the two parties, at the rate of 5 cents per 1,000 cu. ft. for gas having a heating value of 1,000 B.t.u. per cu. ft.

Arizona Protests Rates of El Paso, Western Companies

WASHINGTON, D. C.—The Federal Power Commission has received a complaint filed by Gov. Sidney P. Osborn, of Arizona, asking that the commission establish just and reasonable wholesale rates for natural gas sold by Western Gas Co. and El Paso Natural Gas Co. to various distributors operating in Tucson, Bisbee, Phoenix, and other Arizona communities.

The complaint alleges that the companies "have entered into unconscionable and monopolistic and preferential agreements for wrongful control of market areas and the maintenance of exorbitant rates and charges with various public-service corporations within the State of Arizona engaged in the retail and distribution of natural gas . . ." and that the wholesale rate charged per therm of natural gas vitally enters into, and materially influences the retail rates to ultimate consumers within the state.

It is further alleged that retail natural-gas rates for domestic purposes in Phoenix are among the highest in the United States.

FPC Denies Plea for Delay In Panhandle Eastern Hearing

WASHINGTON, D. C.—The Federal Power Commission last week denied a petition by Panhandle Eastern Pipe Line Co. and Michigan Gas Transmission Corp. for a 120-day continuance of the hearing previously scheduled to have been resumed March 18. The order of denial directs that hearing be resumed at 9:45 a.m., March 30, 1942, in the commission's hearing room in Washington.

The hearing which was recessed in Detroit on March 3, was ordered by the commission as a result of a complaint filed in March 1941, alleging unjust and discriminatory rates charged for natural gas sold to Michigan Consolidated Gas Co. for resale in Detroit and vicinity. The complaint also alleged that an excessive price was paid by Panhandle to Michigan Gas Transmission for transporting Texas and Kansas natural gas from the Indiana-Illinois state line to Detroit. In February 1942 the entire facilities of Michigan Gas Transmission were acquired by Panhandle Eastern.

On July 12, 1941, the commission granted the petition of the Michigan Consolidated Gas Co. of Detroit for leave to intervene in the proceeding. That petition, filed July 10, 1941, stated that Michigan Consolidated distributes gas to some 435,000 consumers in Detroit and vicinity, which gas has been purchased from Panhandle Eastern and delivered to Michigan Consolidated through the facilities of the Michigan Gas Transmission Corp.

A.G.A. Conference Points Way to Greater Part for Gas in War

PITTSBURGH, Pa.—More than 250 industrial and commercial delegates from gas utility and equipment companies from 26 states and Canada attended the A.G.A. Industrial and Commercial Gas Conference here March 12 and 13. All the speakers emphasized how industrial and commercial gas and equipment could be more effectively utilized to increase war production. There were 31 speakers on the program, and the keynote of the conference was struck by Edward M. Borger, president, Peoples Natural Gas Co., Pittsburgh, in his, the first address on the program, on "Industrial and Commercial Gas Engineers—Their Vital Role in the War Effort."

Natural Gasoline

Natural-Gasoline Plant Survey Made in District 3

SHREVEPORT, La.—Survey of nearly 800 natural-gasoline and recycling plants has been completed in District 3 for the purpose of determining what changes or additions could be made quickly to increase production of 100-octane gasoline and synthetic-rubber components. Disclosure that the extensive survey had been completed was made by N. C. McGowen, Shreveport, president of the United Gas Pipe Line Co., Union Producing Co., and chairman of the District 3 natural gas and natural gasoline committee.

This report has been forwarded to the Office of Petroleum Coordinator, Washington, D. C., under which his committee functions, Mr. McGowen said.

He added that from a normal production of 40,000 bbl. per day, production of high-octane gasoline has already been increased to 60,000 and will shortly be boosted to 100,000 bbl. per day; but to obtain the goal of 250,000 bbl. per day already declared needed by the United States war machine may require up to 2 years' time.

Mr. McGowen praised Order M-68 as the most constructive ever made for the oil industry and said it was being administered by men recruited from the oil industry and not by "bureaucrats" or "autocrats." He estimated the order had already reduced use of steel by the industry by 50 per cent.

SOUTHWESTERN GAS MEASUREMENT SHORT COURSE

Seated: E. L. Stark, Foxboro Co.; Earl Kightlinger, Arkansas Louisiana Gas Co.; J. H. Page, Kansas Corporation Commission; Max K. Watson, Canadian River Gas Co.; G. W. McCullough, Phillips Petroleum Co.; W. H. Carson, University of Oklahoma; Kate A. Niblack, Oklahoma Utilities Association; E. C. McAninch, Oklahoma Natural Gas Co., and R. M. Scofield, Lone Star Gas Co. Standing: R. L. Rountree, United Gas Pipe Line Co.; J. L. Griffin, Northern Natural Gas Co.; W. R. McLaughlin, Pittsburgh Equitable Meter Co.; W. F. Lowe, Natural Gasoline Association of America, and L. G. Rheinberger, Sinclair Prairie Oil Co.

The eighteenth Southwestern gas measurement short course will be held at the University of Oklahoma, Norman, on April 21, 22, and 23, 1942. Max K. Watson, Canadian River Gas Co., is chairman of the program committee. Members of the general committee are shown above.

During the short course a general meeting will be held each morning and topics of interest to all will be discussed. The afternoons have been set aside for classes covering a wide variety of subjects but all relating to gas measurement.

Among the speakers before the general assembly will be: Burt R. Bay, president, Northern Natural Gas Co., and Reford Bond, chairman of the Corporation Commission of Oklahoma. The morning of April 23 has been set aside for the discussion of the fundamental principles involved in all phases of gas metering and regulating practices. In selecting subjects for the 48 afternoon classes, the committee has been cognizant of the problems facing the gas industry due to the war. Many fundamental subjects will be offered for the benefit of the hundreds of men who have been employed in gas-measurement work in recent months. There will also be advanced classes for the more experienced men. C. E. Terrell, chairman of the exhibits committee, announced that 19 companies will present educational displays.

Recycling News

Superior Oil Lets Contract For Recycling Plant

Superior Oil Co. of California, Houston, Tex., has let contract to the Fluor Corp. for the construction of a recycling plant to be built in the Lake Creek field, Montgomery County, Texas. Location of the plant is being cleared and construction is to be started in the near future. The plant will be capable of handling approximately 65,000,000 cu. ft. of gas daily.

ANNUAL REFINERY NUMBER

Beginning Special Section

War dominates the construction and operating routine of the refining industry. War has greatly quickened the adoption of complicated chemical and thermal procedures required in the syntheses of war-time aviation fuels. In war as in peace the refineries of the country are adjusting themselves to the needs of the times.

Experiences of Operating Refinery in War Area

The Oil and Gas Journal is pleased to present here the message of an executive of a large refining company regarding the protection of plants against bombing attack and sabotage. He requests that his name and that of his company be omitted. In order that the published data reflect weight he recites the experiences gained in a refinery located in France, which plant went through actual invasion. It is submitted as a suggestion for other refiners and it bears the approval for publication of the War Department.

WITH the present-day interest in plant protection and the all-out effort on the part of refinery executives and personnel to be ready for the worst, should it come, a review of experiences in operating a refinery in France before and during the first year of the war may be of help. At least it will relate incidents and methods which were tried and show the results that were obtained.

All industries in France, because of the military status of most employes, had done much work in making arrangements for replacing and shifting employes under actual war conditions. The necessity of such planning is apparent when consideration is given to the organization of the French military establishment. In many cases this meant that certain employes would report to a designated spot for services immediately upon announcement of general mobilization. In other cases, men would be required to report at a specified date after mobilization to other jobs, usually in other industries.

In order to retain experienced men in key positions, applications for deferment from military service, or other special duty, were made by the company. These deferments were very hard to obtain. As an example, we could not obtain deferment for the assistant superintendent and many leading operators. Of necessity, we had to be ready to carry on, not only our normal activities but the greatly increased demand for petroleum products when the French Government called upon us to supply its needs. We had to do this in face of the loss of many important members of our organization.

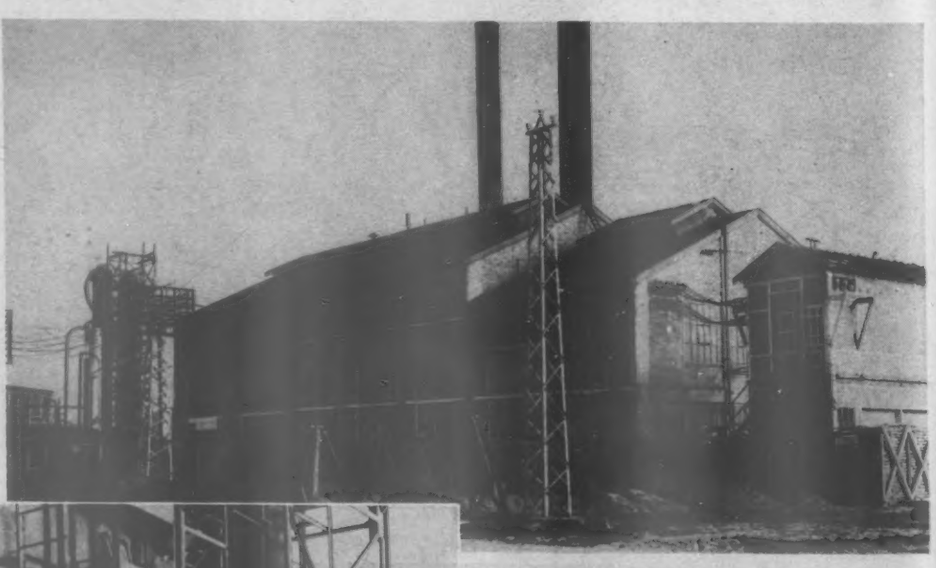
To add further to operating difficulties, mobile equipment such as trucks and passenger cars were subject to requisition at specified dates following general mobilization. In fact, one of our trucks was taken on the second day of the war.

There were numerous questionnaires and requests for specific information for the government to be handled at any hour of the day or night. This was a particularly serious problem immediately preceding the war.

Discussions pertaining to blackouts, protection against sabotage, etc., started at the time of the Munich incident. Following this, definite plans were laid and even executed for screening burners, masking windows, and reducing lighting in general.

We followed two methods of handling lighting: (1) War-time lighting, intended to reduce glare in the sky; and (2) alert lighting, which meant that no light could be visible. The plant was operated totally blacked out from the time war was declared. Windows were covered with black canvas curtains or wooden shutters were fitted tightly enough to retain all light. Where the window space was too large to be completely screened, indispensable inside lights and boiler fires were screened individually. All outside structural lights or those normally used for general illumination were eliminated. All outside furnace fires were screened by use of angle-iron frames with canvas painted black and stretched tightly over the frames. The entrances were baffled and the canvas tied down so no light was visible underneath. Light was not permitted to escape at doorways. Control houses and other buildings vital to continuous operations were entered through a "light lock."

Where external lighting was needed, we found that by reducing the wattage and reflecting the lights downward on a black painted surface they were not visible from an elevation. Colored lights were not successful as substitutes for white



(Right): Sand bags and crates built around important buildings. (Below): Canvas-covered steel frames were set in front of the furnaces to eliminate direct light from the furnace doors

lights. Flashlights were masked by the use of carbon paper. These proved extremely valuable in continuing operations, such as reading gages, gaging tanks, and making transfers of oil from one tank to another.

Of course the reduction in light increased the danger from sabotage and also increased the hazards of operations. The number of guards was greatly increased. One of the most effective means of guarding against illegal entry was by the use of specially trained dogs. Special identity cards were issued to our personnel, also to that of outside contractors and their employes.

Hard to Hide

Any effort toward camouflage or protective obscuration to afford protection from bombing was difficult because the refinery was located on a point of land where two rivers flow together and camouflage would not in this case be effective.

About the only attempt made to camouflage was to paint our aluminum tanks a dirty green color. Our principal efforts were devoted to reducing the probable damage from bomb splinters to our personnel and equipment. The use of sand bags was very effective as protection against flying splinters. One illustration shows how these were placed around one of our vital units. As the bags began rotting within 6 to 8 months, it was necessary to replace them and in many cases to rebuild walls.

At the beginning of the war, the French Government required us to start building circular concrete reinforced walls around all tanks of more than 20,000-bbl. capacity, and these were completed around all of our gasoline tanks early in 1940. These walls were about 40 in. thick at the bottom and 30 in. thick at the top and were four-fifths the height of the tank. They were expensive to build and presented difficulties when changing valves on tank outlets, but they were very effective except in the case of a direct hit. While no picture of the complete wall is available, illustration shows the effect on the concrete wall of a nearby bomb explosion. Obviously a steel tank would not have withstood the action of these bomb splinters.

Effect of a bomb on a concrete wall cast around an important tank. The concrete was reinforced and was 40 in. thick near the base and 30 in. thick at the top

Bombproof shelters were constructed for protection of the personnel. During raids after the German occupation they were used by the Germans to the extent that there was little room for our employes. Individual steel shelters were located at various vital points in the plant. Gas masks were provided for all employes, and these were carefully inspected and maintained.

No Order Sent to Destroy

Until the fall of Paris, the French maintained guards. When France fell, they were replaced by German Army guards. The French had issued orders that in event of prospective capture, we would be notified to destroy the plant. After the armistice, however, these orders were rescinded.

When the Germans occupied the plant they mounted antiaircraft machine guns but apparently did not anticipate an attack by the British. They took control of all stocks and prepared to ship them. But before this shipment started, the British bombed the plant, dropping explosive bombs and some incendiaries. This was in the summer of 1940. Extensive damage was done to the tank farm and large fires started. The Germans were equipped with fire-fighting apparatus but evidently had little knowledge of the proper methods in extinguishing oil fires, and we were given no opportunity to help them in using the apparatus, they suspecting we might have ulterior motives.

Operating Units Stand

After this attack, the Germans moved in heavy antiaircraft guns. The British returned 5 nights later, concentrating their attack on the storage tanks, and it was obvious that they were not attempting to hit the operating units. Their bombs completely disrupted all water and power supplies and having no portable, self-powered auxiliary fire equipment available it was impossible to combat the resultant fires, which burned for 8 days.

Although the units were not hit directly, some damage was done by splinters and the concussions of high explosives. None of our employes were injured, although a direct hit was scored by the British on an antiaircraft battery operated by the Germans, killing the crew of four.

The damage done by these bombing raids was severe, tanks were burned, houses occupied by our personnel completely destroyed or made uninhabitable, most of the window glass was broken, but actually the operating units were not greatly harmed. Of course, practically all of the products in storage were destroyed.

Our experiences under these conditions showed the value of having plenty of wooden plugs available to plug holes in tanks, and fire walls in good condition prevented an even greater loss of tanks through the fires which burned for 8 days.

Our experience under these two attacks proved that it would take a great deal of accurate bombing to completely destroy an entire plant.

Sand bags shielded the small equipment when placed in the passageways of normally open installations

Propane—A Substitute for Butane in Motor Fuels

By R. C. ALDEN, H. M. TRIMBLE and L. A. McREYNOLDS
Research Department, Phillips Petroleum Co.

THE average quantity of butane in United States motor fuel produced in 1941 was approximately 100,000 bbl. per day. This calculation assumes an average of 6 per cent in motor fuel.[1] During recent years, butane has been included in motor fuel to the maximum extent compatible with prevailing generalized specifications which in turn were based on intensive studies of automotive fuel induction systems. These latter have been steadily improved so that increased horsepower of automotive engines has not interfered with this progressive trend. On the refining side depropanization of motor fuels has been developed to a high degree to permit inclusion of the maximum quantities of butane.

Not only has the development been sound from the viewpoint of refinery economics but it has been an outstanding conservation method since, in effect, it serves to reduce crude oil requirements[2]. It has been one of the contributing factors to the low price of motor fuel. Furthermore, the use of maximum butane has had a substantial part to play in the rapid improvement of motor fuel quality. Easy starting and antiknock properties are favorably affected by butane inclusion, while vapor-lock and evaporation losses are adversely affected.

In recent months much has been said and written about an impending shortage of butane as a result of the rapidly increasing demands for "C_4" hydrocarbons for the manufacture of aviation gasoline, synthetic rubber and other munitions of war. In such a condition all, or a part of, the 100,000 bbl. per day of butane in motor fuel may be diverted to other uses. The question naturally arises as to the quality of motor fuel deprived of butane. Also it seems fairly obvious that in such an eventuality the petroleum industry would turn to propane and propylene to replace the diverted butane so that at least part of the quality and economic losses could be regained.

When carried to the limit, the 100,000 bbl. per day of butane now in motor fuel could be replaced by about 28,000 bbl. of propane for the production of a gasoline of equal vapor pressure. It is very doubtful, of course, if such a program could be carried to the limit. A 50 to 75 per cent realization probably would be the practical maximum for an "all-out" effort. The potential supply of propane in United States refineries and natural-gasoline plants has been estimated[2a] at 310,000 bbl. per day, with 57,400 bbl. per day now being used as such and an estimated 147,000 bbl. per day now definitely not extracted. The intermediate portion (105,600 bbl. per day) represents propane in various stages of concentration, ranging from immediate to difficult availability. Considerable proportions of this intermediate supply are readily available.

It is recognized by the authors that propane cannot possibly be exactly equivalent to butane as an ingredient of motor fuel. However, even the most casual consideration will convince one that propanized gasoline is better economically and qualitatively than gasoline containing nothing lighter than C_3 hydrocarbons.

Blends

For the purposes of this paper three butane-free gasolines having 30, 45 and 60 per cent

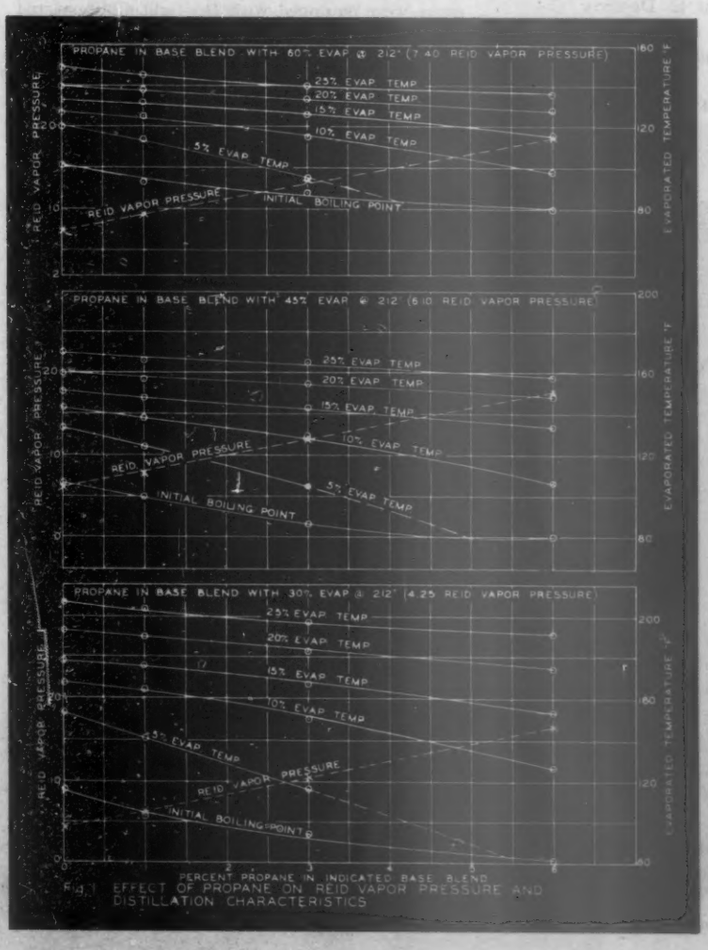

PROPANE IN BASE BLEND WITH 60% EVAP @ 212° (7.40 REID VAPOR PRESSURE)
25% EVAP TEMP
20% EVAP TEMP
15% EVAP TEMP
10% EVAP TEMP
5% EVAP TEMP
REID VAPOR PRESSURE
INITIAL BOILING POINT
REID VAPOR PRESSURE
EVAPORATED TEMPERATURE °F
PROPANE IN BASE BLEND WITH 45% EVAP @ 212° (6.10 REID VAPOR PRESSURE)
PROPANE IN BASE BLEND WITH 30% EVAP @ 212° (4.25 REID VAPOR PRESSURE)
PERCENT PROPANE IN INDICATED BASE BLEND

Fig. 1 EFFECT OF PROPANE ON REID VAPOR PRESSURE AND DISTILLATION CHARACTERISTICS

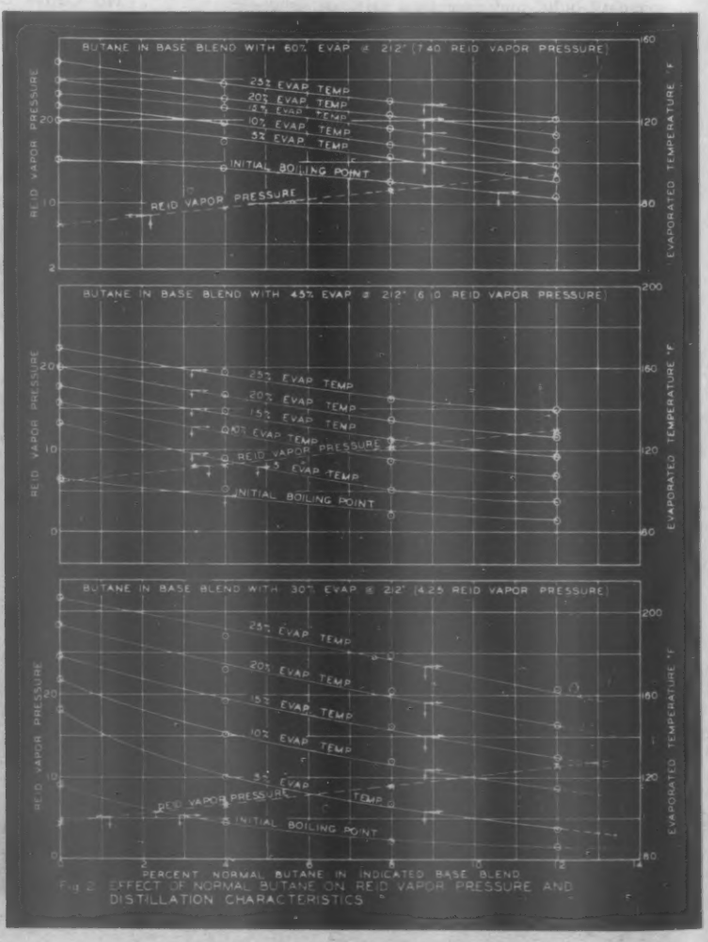

BUTANE IN BASE BLEND WITH 60% EVAP @ 212° (7.40 REID VAPOR PRESSURE)
25% EVAP TEMP
20% EVAP TEMP
15% EVAP TEMP
10% EVAP TEMP
5% EVAP TEMP
INITIAL BOILING POINT
REID VAPOR PRESSURE
REID VAPOR PRESSURE
EVAPORATED TEMPERATURE °F
BUTANE IN BASE BLEND WITH 45% EVAP @ 212° (6.10 REID VAPOR PRESSURE)
BUTANE IN BASE BLEND WITH 30% EVAP @ 212° (4.25 REID VAPOR PRESSURE)
PERCENT NORMAL BUTANE IN INDICATED BASE BLEND

Fig. 2 EFFECT OF NORMAL BUTANE ON REID VAPOR PRESSURE AND DISTILLATION CHARACTERISTICS

evaporated at 212° F. have been blended with propane and normal butane in varying proportions. The Reid vapor pressure and A.S.T.M. distillation characteristics of the several blends have been determined for application to the numerous published correlations with various operating qualities of motor fuels. Some of the characteristics of these blends are presented graphically in Figs. 1 and 2.

Vapor Lock

Vapor lock has been defined as the partial or complete interruption of gasoline flow in the fuel feed system resulting from the formation of bubbles of vapor or gas. In actual practice vapor locking is occasioned by the rise in temperature of the gasoline in the fuel feed system. This rise in temperature is caused by heat originating from the engine. If the rise in temperature is high enough, the vapor pressure of the gasoline may increase enough to cause boiling and thereby produce vapor locking. Oberfell has pointed out[3,4,9] that the vapor-locking effects of propane in gasoline had been misunderstood and overemphasized. It was his opinion that if two gasolines have the same vapor pressure when they enter the fuel feed system, the one with propane would have the higher vapor-lock temperature in actual practice if all conditions of service were exactly the same in both cases.

More recently, a vapor-lock chart for the correlation of car and fuel vapor-locking characteristics has been developed by Barber and Kulason[5]. By means of this chart the vapor-forming characteristics of a gasoline can be approximated from the Reid vapor pressure and A.S.T.M. distillation tests on the gasoline. The abscissa represents the vapor tolerance (V/L) of the fuel system. This factor has been found to vary from as little as 1 or 2 to as much as 50 or 60 for different cars, depending on the plumbing of the fuel system being observed.[5]

The data of Table 1 show the application of the Reid vapor pressure and distillation characteristics of the aforementioned propanized and butanized gasolines to the relationship established by Barber and Kulason[5]. The data show large increases in the vapor-locking fuel temperatures when propane is substituted for butane to equal Reid vapor pressures. The obvious conclusion is that for equal vapor-locking tendencies motor fuels can be of somewhat higher vapor pressure than butanized motor fuels. The data indicate these vapor pressure increases could be considerably higher with winter than with summer gasolines.

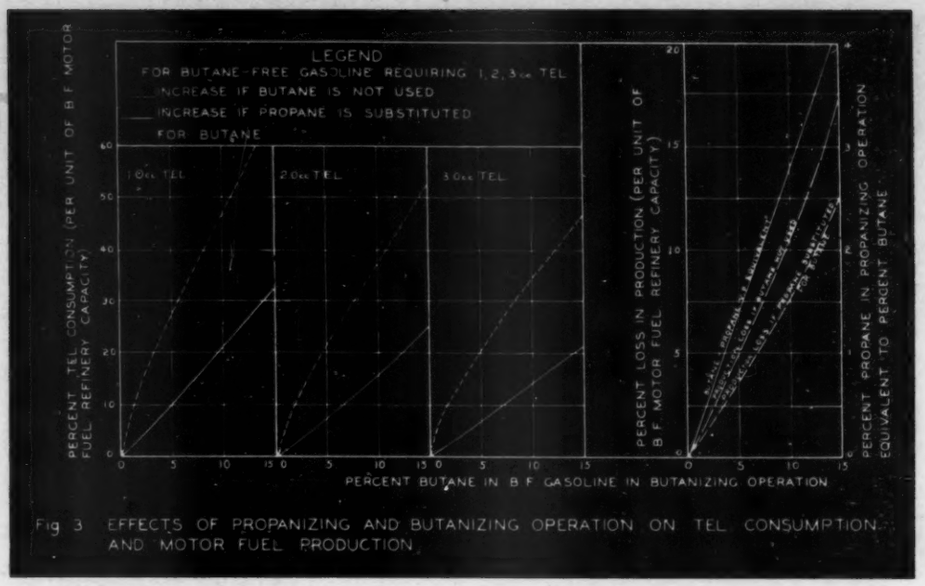

LEGEND
FOR BUTANE-FREE GASOLINE REQUIRING 1, 2, 3 cc. TEL
INCREASE IF BUTANE IS NOT USED
INCREASE IF PROPANE IS SUBSTITUTED FOR BUTANE
1 Cc. TEL
2 Cc. TEL
3 Cc. TEL
PERCENT TEL CONSUMPTION (PER UNIT OF B.F. MOTOR FUEL REFINERY CAPACITY)
PERCENT LOSS IN PRODUCTION (PER UNIT OF B.F. MOTOR FUEL REFINERY CAPACITY)
PERCENT PROPANE IN PROPANIZING OPERATION EQUIVALENT TO PERCENT BUTANE
PERCENT BUTANE IN B.F. GASOLINE IN BUTANIZING OPERATION

Fig. 3 EFFECTS OF PROPANIZING AND BUTANIZING OPERATION ON TEL CONSUMPTION AND MOTOR FUEL PRODUCTION

As a result of investigations of Bridgeman and Cragoe[6] the following conclusions were reached regarding ease of starting:

1. The leanest mixture which will explode in a cylinder is a 20:1 resultant air-vapor mixture.

2. The richest mixture which the average carburetor will supply to a motor (with full choke) is a 1:1 air-fuel mixture.

3. In order to start a motor at the lowest possible atmospheric (engine) temperature using the leanest air-vapor mixture (20:1) and a full choke (1:1 air-fuel mixture) it is necessary for 1/20 or 5 per cent of the fuel to be vaporized at the given temperature. The 5 per cent point on the A.S.T.M. distillation curve is therefore taken as the critical point for the lowest possible starting temperature of a motor fuel.

4. A somewhat richer mixture (12:1 air-vapor mixture) is taken as the criterion for easy or satisfactory starting, which is defined as that condition which produces the first explosion with 10 engine revolutions or less. In order to supply this mixture, it is necessary that 1/12 or 8⅓ per cent of the fuel be vaporized at the given temperature, hence the 8⅓ per cent point on the A.S.T.M. distillation curve is taken as the critical point for easy starting.

From the relationships set forth[4] it can be established that for "possible starting" and "easy starting," the A.S.T.M. distillation evaporated temperatures of the gasoline must be as follows:

For atmospheric (engine) temperatures at or below (F.)	5% temp., F. (maximum) possible starting	8⅓ % temp., F. (maximum) easy starting
—40	86	74
—20	112	100
0	139	126
20	165	151
40	191	177

The relationship set forth above and the data shown in Figs. 1 and 2 were used to arrive at the facts presented in Table 2.

"Possible starting" can be obtained with butane-free motor fuels at quite low temperatures. Even "easy starting" is obtainable for most butane-free fuels at atmospheric temperatures above freezing. Propanizing as contrasted with butanizing to the same vapor pressure provides starting at only slightly higher atmospheric temperatures, particularly in the case of winter gasolines where this characteristic is most essential. If it were possible to take advantage of the increased vapor pressure permissible from the vapor lock viewpoint the starting qualities of winter propanized gasolines would be equal to or better than those of winter butanized gasolines. Of course, propanized winter motor fuels have considerably better starting characteristics than gasoline containing no volatilizing agent.

TEL Effect

One very important characteristic of the light hydrocarbons is their high blending octane number, with a resulting saving in tetraethyl lead in blends to which they have been added. Neptune and Trimble have pointed out the octane value of several economically important light hydrocarbons within motor-fuel range,[7] and suggested a method of calculating the TEL saved by the addition of light hydrocarbons to motor fuels. In the subsequent calculations the relative TEL consumptions are based on the foregoing methods of calculation assuming that propane has the same blending antiknock characteristics as isobutane. The results of these calculations are shown in Fig. 3.

The dashed lines in the left three-segment por-

(Continued on Page 122)

TABLE 1—FRONT-END-DISTILLATION CHARACTERISTICS AND RELATIVE VAPOR-LOCKING TENDENCIES OF BLENDS CONTAINING PROPANE AND NORMAL BUTANE

Description—	R.v.p.	A.S.T.M. evaporated temp. °F. 5%	10%	15%	20%	Temperature (°F.) at which vapor lock will occur V/L = 20	V/L = 30
30% evap. at 212°	4.25	153	167	178	193	187	above 190
30% evap. at 212° + 1.8% propane	8.00	131	159	173	188	181	above 190
30% evap. at 212° + 6.3% *n*-butane	8.00	111	132	149	165	151	168
30% evap. at 212° + 3.7% propane	12.00	107	146	165	181	164	185
30% evap. at 212° + 12.8% *n*-butane	12.00	93	112	128	143	123	141
45% evap. at 212°	6.10	133	143	151	160	162	168
45% evap. at 212° + 1.0% propane	8.00	125	138	148	158	158	166
45% evap. at 212° + 3.6% *n*-butane	8.00	117	129	139	149	151	155
45% evap. at 212° + 3.0% propane	12.00	105	128	143	156	146	161
45% evap. at 212° + 11.0% *n*-butane	12.00	96	109	119	128	123	130
60% evap. at 212°	7.40	120	127	133	140	144	148
60% evap. at 212° + 0.4% propane	8.00	118	126	132	139	143	148
60% evap. at 212° + 1.3% *n*-butane	8.00	118	125	131	137	142	147
60% evap. at 212° + 2.4% propane	12.00	101	119	128	135	134	141
60% evap. at 212° + 8.7% *n*-butane	12.00	100	107	115	121	119	124

TABLE 2—RELATIVE EASE OF STARTING OF BLENDS CONTAINING PROPANE AND NORMAL BUTANE

Description—	R.v.p.	Temp. °F. for possible starting	Temp. °F. for easy starting
30% evap. at 212° F.	4.25	11	28
30% evap. at 212° F. + 1.8% propane	8.00	—6	20
30% evap. at 212° F. + 6.3% *n*-butane	8.00	—21	0
30% evap. at 212° F. + 3.7% propane	12.00	—24	7
30% evap. at 212° F. + 12.8% *n*-butane	12.00	—35	—15
45% evap. at 212° F.	6.10	—4	11
45% evap. at 212° F. + 1.0% propane	8.00	—10	6
45% evap. at 212° F. + 3.6% *n*-butane	8.00	—17	—1
45% evap. at 212° F. + 3.0% propane	12.00	—25	—4
45% evap. at 212° F. + 11.0% *n*-butane	12.00	—33	—16
60% evap. at 212° F.	7.40	—14	—1
60% evap. at 212° F. + 0.4% propane	8.00	—16	—2
60% evap. at 212° F. + 1.3% *n*-butane	8.00	—16	—2
60% evap. at 212° F. + 2.4% propane	12.00	—29	—10
60% evap. at 212° F. + 8.7% *n*-butane	12.00	—30	—17

Gasoline Additives . . .

By JOSEPH A. MOLLER
Chief Products Engineer, Pure Oil Co.

IN 1924 the average passenger-car engine of approximately 200-cu. in. displacement developed a brake horsepower of about 60 to 65, and in 1940 the same 200-cu. in. passenger-car engine developed a brake horsepower of approximately 85 to 95. In other words, from the same engine displacement in cubic inches, approximately 30 per cent more power is obtained. Normally a 30 per cent increase in power output would be thought of as the result of improved design, better production methods, and better materials available to the automotive-engine manufacturer. As a matter of fact, the increased power is also reflected in the decreased antiknock quality of the engine.

To illustrate this, Fig. 1 is a graph taken from

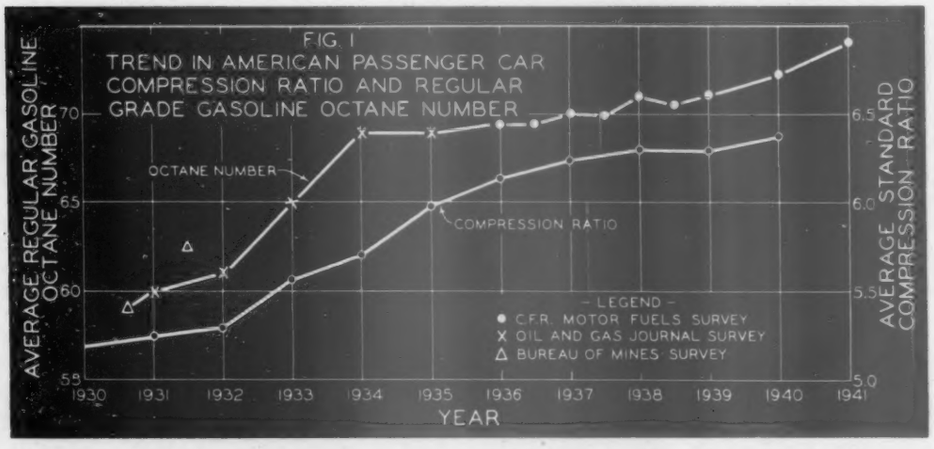


FIG. 1
TREND IN AMERICAN PASSENGER CAR COMPRESSION RATIO AND REGULAR GRADE GASOLINE OCTANE NUMBER
AVERAGE REGULAR GASOLINE OCTANE NUMBER
AVERAGE STANDARD COMPRESSION RATIO
OCTANE NUMBER
COMPRESSION RATIO
- LEGEND -
● C.F.R. MOTOR FUELS SURVEY
X OIL AND GAS JOURNAL SURVEY
Δ BUREAU OF MINES SURVEY
YEAR

a paper presented before National Petroleum Association, Cleveland, Ohio, on April 19, 1940, by a representative of an automotive-engine manufacturer.[1] This figure simply illustrates the fact that, over a period of years, the average passenger-car engine produced has an antiknock quality, or an octane requirement, which is somewhat below, but follows, the octane value of the average house-brand gasoline sold over the same period of years. However, what this curve does not show is that during the same years certain cars (which may be termed car leaders) were put on the market by various automotive manufacturers. The requirements of the engines of the car-leader classification definitely exceeded, and was ahead of, the curve of octane of the average house-brand gasoline. These cars had to be serviced with the so-called premium type of gasoline. Therefore, while this curve is indeed a nice curve from the engine manufacturer's point of view, in that it shows that he has constantly followed, yet constantly taken advantage of, the increase of octane of the average house-brand fuel, the curve does not show the requirements of the car leaders during the same 10-year period. Doubtless it was the car-leader requirement which, more than any other factor, was the real factor in constantly forcing the octane of house-brand gasoline upwards during this period.

It might be considered almost axiomatic that the engine-octane requirement and the fuel-octane rating must add up to some sort of a constant. In other words, for a particular engine of a particular design, as changes are made to increase power output, for example, advancing the spark, increasing the compression ratio, etc., the antiknock quality of the engine itself is decreased. Hence, the octane number of the fuel required for a no-knock performance for that engine under a given set of conditions must be correspondingly increased.

Relationship of Factors

Considering, for example, but three of the fundamental characteristics which may be changed in an engine to increase power output or driving economy, it is found that they bear definite relationship with the antiknock quality of the engine, and hence with the antiknock quality of the fuel which must be supplied to that engine. Fifteen years ago little was heard regarding the antiknock quality fuel or of the engine. It is true that the word "octane" had been suggested as early as 1924 as a scale, or yardstick, for measuring or evaluating the antiknock quality of fuels and engines, but little was known regarding the antiknock qualities of either until some years later.

Considering but one of the engine characteristics for a moment, compression ratio, Fig. 2

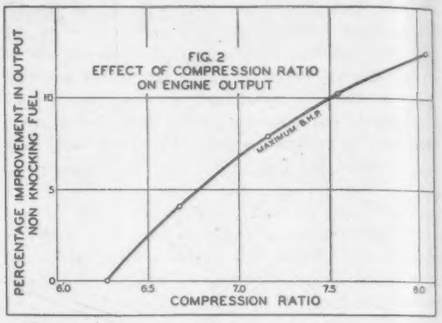
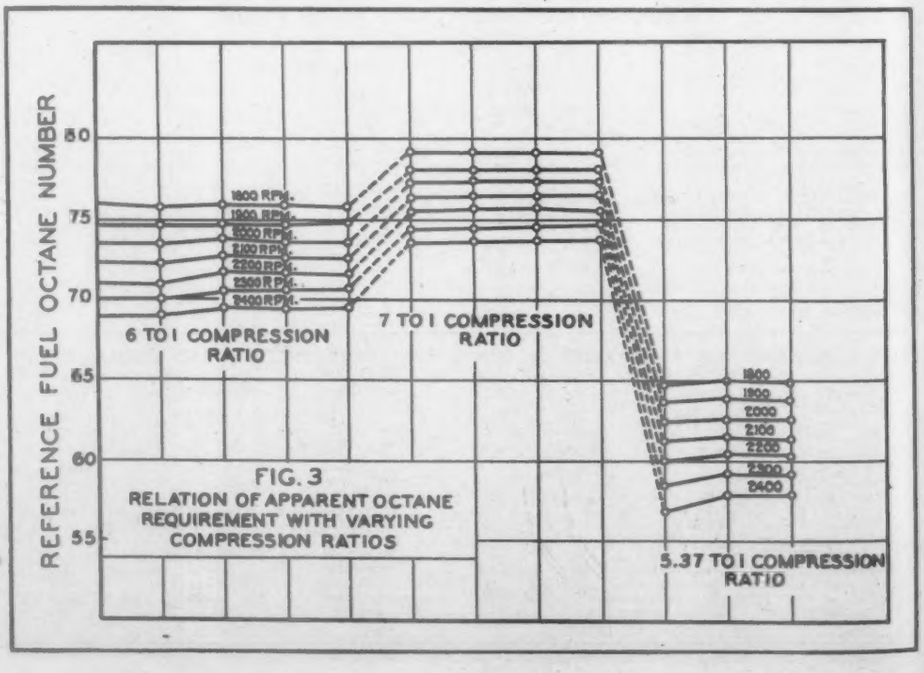


FIG. 2
EFFECT OF COMPRESSION RATIO ON ENGINE OUTPUT
PERCENTAGE IMPROVEMENT IN OUTPUT NON KNOCKING FUEL
MAXIMUM B.H.P.
COMPRESSION RATIO

illustrates quite graphically the effect of increasing compression ratio. The possible increase in engine output is shown in percentage when plotted against compression ratio using a non-knocking fuel. For example, an increase of compression ratio from 6½ to 7½:1 increases the power output of the engine approximately 7 per cent. Seven per cent does not seem like much of an increase until one considers the fact that some 16 years of research and development work was necessary to obtain a 30 per cent power-output increase from engines of the same displacement. Viewing the results in this light, 7 per cent would represent 4 years of expensive and laborious research work on the part of the engine designer and builder. Now that the increase in power output, due to an increase in compression ratio, has been shown for a particular engine, it might be worth while to see the cost of this increase expressed in increased fuel-octane requirement of the engine.

Effect of Raising Compression

Fig. 3 illustrates the increased octane requirement of the engine versus increased compression ratio. For example, if the compression ratio of an



[1]Macauley, J. B., "The Octane-Number Problem From the Automobile Viewpoint."

engine is increased from 6 to 7:1, the octane requirement of that engine at 40 m.p.h. is increased from 72.6 to 76.4. From Fig. 2 it was noted that an increased compression ratio of 1 meant an increase in engine output of approximately 7 per cent; and in Fig. 3 it is noted that the increase of compression ratio of 1 increases the octane requirement of the engine nearly four octane numbers at the selected speed. It is obvious that, since all other conditions have been maintained as nearly the same as possible, the greater portion of the actual burden of the cost of increasing the output of the engine has, by means of increased compression ratio, been placed directly upon the fuel.

To digress for a moment, it might be worth while to note Fig. 4, which is simply a curve of

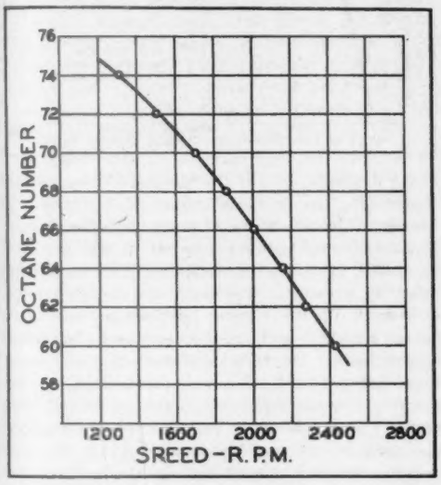


Fig. 4—Requirement curve taken to obtain apparent octane requirement of engine at a particular time and for a particular condition

engine-octane requirement taken in the laboratory at a particular time. The curve is really the boundary line between the knock and no-knock region, using fuels of known octane rating and varying the speed of the engine.

Perhaps one of the next most-important design characteristics of an engine is that of spark advance. In Fig. 5 the fact that increased spark advance increases the fuel requirement for that engine is clearly shown. For example, a particular engine using a 10° spark advance required, at about 40 m.p.h., a fuel of approximately 62 octane rating. For a 20° spark advance the same engine, all other conditions being equal, required a fuel of about 68.5 octane number. A further spark advance of 10°, making a total of 30° spark advance, brought the requirement up to 73.6, while a 40° spark advance brought the octane requirement of that engine up to 75.7. Again the fact that as engine performance is increased by means of advanced spark, the increase is paid for directly through the increased requirement of a higher-octane fuel.

Illustrating this point, Fig. 6 simply shows a curve of a 1941 passenger-car engine. Note the fact that there are two spark-advance curves. One of these curves is entitled "The standard spark advance," while the other is entitled "The maximum-power spark advance." Note also that there are two brake-horsepower curves. One of these curves is taken at optimum, or maximum, spark advance while the other is taken at the standard spark advance. The work done for these curves was done on a chassis dynamometer, and the brake horsepower is, consequently, taken at the tires. The reason for the two spark-advance curves is that if the maximum-power spark-advance

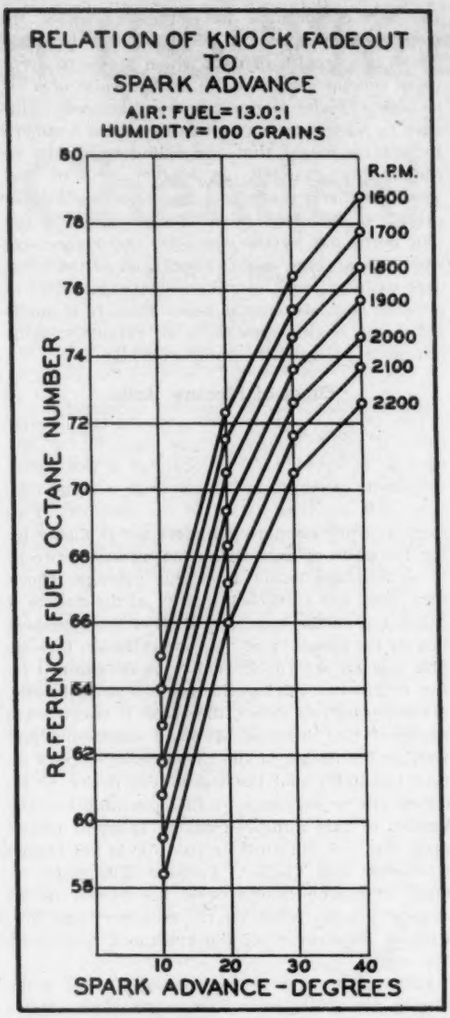
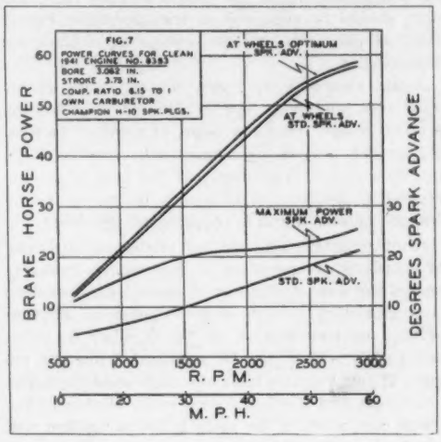


Fig. 5—Increase in octane requirement at various speeds and advanced spark

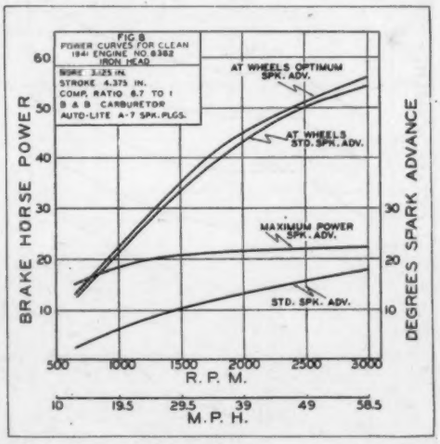
curve is used, more power is available at the wheels. However, were this spark advance used, the car would require a fuel of an octane number not commercially available in service stations today; and, therefore, the manufacturer of this engine would have customers who would be constantly dissatisfied with their engine's performance because of excessive knocking conditions. Therefore, the manufacturer of this engine has to set the spark advance to the point where the octane requirement of the engine is reduced so that commercially available fuels will perform satisfactorily in the engine even at the decrease of power output as illustrated by the two brake-horsepower curves.

Obviously the engine manufacturers would like to use the maximum, or optimum, spark advance for his engine. However, he cannot do so until, and unless, fuels are commercially available of a high-enough octane value to offset the loss in antiknock quality of the engine, which it would have were the maximum power spark advance used. Again it is seen that increased engine performance, or power output, is obtained directly at the expense of increased fuel-octane requirement. Fig. 7 simply shows the same characteris-

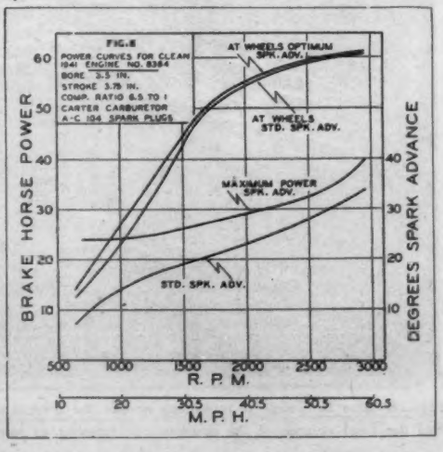


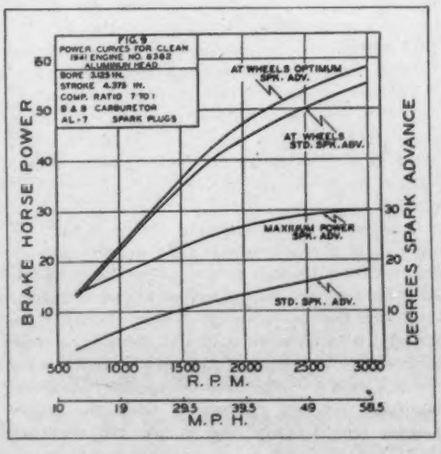
tics as does Fig. 6 for another popular 1941 passenger-car engine.

To further illustrate the point, Fig. 8 shows



the same characteristics for another 1941 passenger-car engine. This curve was taken using an aluminum cylinder-block head. In Fig. 9 the same





engine was used, but the aluminum head was changed to an iron head. To repeat, the only difference between the two engines in Figs. 8 and 9 is the fact that one had the aluminum head and one had the iron head. It is quite obvious that the aluminum head gives better engine characteristics from the point of view of antiknock requirement. Due to the present emergency, it is obvious that the substitution of iron heads materially changes the octane requirements of the engines as illustrated by these last two figures provided compensating features are not incorporated in the engine. However, perhaps the average passenger car in use today, and for the duration, should be regarded as transportation rather than as the acme of the science of combustion engineering.

Again summing up these curves, it would appear that increased spark advance may be improved design from the point of view of increasing power output per cubic inch displacement, but it would also appear that the cost of the increased power output is largely borne by the increased octane number required of the fuel.

Another interesting subject of discussion is one of economy of operation of the engine. Probably one of the most commonly discussed car-operation characteristics between engine operators, whether private or commercial, is the number of miles per gallon which can be obtained from the engine. If two engines have the same cubic-inch displacement and the same gear ratio, obviously the leaner the mixture the more miles per gallon will be obtained. Fig. 10 illustrates graphically the ef-

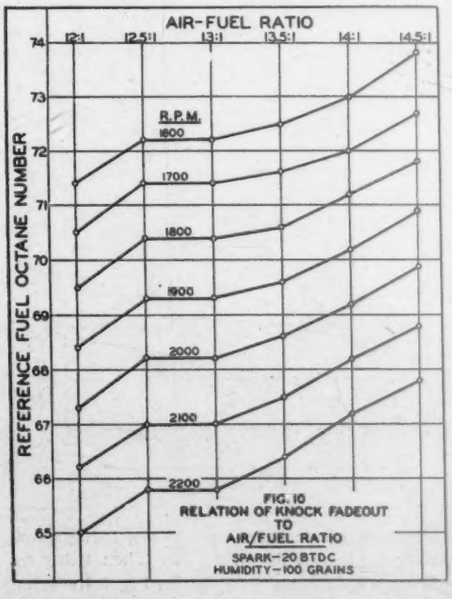


FIG. 10
RELATION OF KNOCK FADEOUT TO AIR/FUEL RATIO
SPARK—20 BTDC
HUMIDITY—100 GRAINS

fect of air-fuel ratio versus octane requirement of the engine. Note that from a ratio of 12 to 13:1 the octane requirement of the engine has been increased, at 40 m.p.h., from 68.4 to 69.3. A further change in the air-fuel ratio to 14:1 would bring the requirement up to 70 octane value. The changing from a 12:1 ratio to a 14:1 ratio increases the octane requirement of that engine by 1.6 octane numbers under these conditions.

However, this is but half of the story. The other half of the story is that in multicylinder engines, due to the design of intake manifold, all cylinders do not receive the same air-fuel ratio. By this is meant that since intake manifolds have to be worked in and around the other parts of the engine, and yet have to be held and fitted within a minimum of space, the intake manifolds are not necessarily what the engine designer would really like to use, but they are the best compromise he can devise under the conditions of space in which he has to work. There is a wealth of data which seems to prove quite conclusively that the air-fuel ratio of a six or eight-cylinder engine may vary between cylinders by as much as two to three ratio numbers. By that is meant that one cylinder may be receiving, for example, an air-fuel ratio of 12:1 while another cylinder may be receiving a 14 or even a 15:1 air-fuel ratio. This statement is further borne out by the every-day occurrence that when the average engine knocks, all of the cylinders do not knock simultaneously; but one, or possibly two, are clearly heard first. It is doubtful if any engine knocks in all cylinders simultaneously, or with the same intensity.

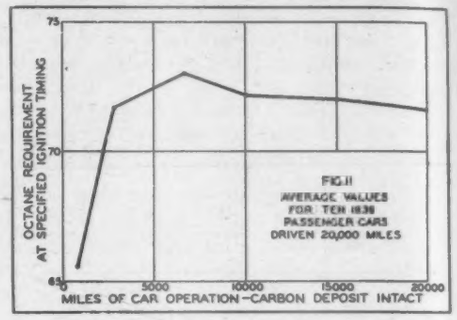
Effect of Mixture Ratio

The point is, that even though the air-fuel ratio, if taken at the exhaust pipe of the car, may be 14, or 14.5:1, it is doubtful if this figure represents anything but the over-all average mixture ratio received by all of the cylinders. Further, that one or more cylinders are probably being forced to operate on air-fuel ratios of two or three numbers leaner than this average. Therefore, since the antiknock quality of the engine is based, not on the knocking of all of the cylinders, but on the knocking of any one cylinder, that engine has an antiknock quality as determined by the cylinder receiving the leanest air-fuel ratio. Summing up this curve, therefore, it would seem apparent that because of space conditions preventing the design of the theoretically correct intake manifold; and because of the desire to increase engine economy of fuel consumption, the burden of this improved design is again placed upon the fuel and must be paid for in yet higher antiknock fuel quality. Perhaps true improvement in engine design could be defined as increased engine performance, economy, and life, without impairment of the antiknock quality of the engine.

Thus far during this discussion it has been simply noted that, as certain engine characteristics are changed to increase power output per cubic inch displacement, the antiknock quality of the fuel must be increased to offset the decreased antiknock quality of the engine. However, only one engine condition has been considered, and that is the new engine condition. In reality, as soon as the engine is used, the factors of normal wear and of deposition, commonly called carbon deposition, begin to occur in the combustion chamber, in and around the rings and ring grooves, the valves and valve stems—to name some of the chief offending locations—and to contribute to decreased engine performance, economy and life.

Decreased engine performance from one point of view may, perhaps, be considered in the light of decreased antiknock quality of the engine. To phrase this another way, to obtain the same performance, a higher-octane-quality fuel is required.

Fig. 11, a graph taken from a paper written by



J. B. Macauley, Jr., of the Chrysler Corp., shows that during the first 5,000 miles of operation, the average fuel-octane requirement of the engine was increased approximately six octane numbers to obtain the same performance. The next 5,000 miles of operation increased the fuel-octane requirement of the engine by perhaps one more octane number, and the curve flattens out after approximately 10,000 miles of operation and maintains approximately a seven fuel-octane requirement above that of the new-car condition. This curve was taken using 10 engines kept in good mechanical condition and driven under so-called average driving conditions for the mileage recorded. The results of the curve simply indicate that the building up and maintenance of the deposition, in so far as the antiknock quality of the fuel required is concerned, is as much as though the compression ratio of the engine had been increased almost by two. To phrase this differently, if the cost in fuel-octane number requirement is 3.8 octane numbers for a 7 per cent increase in power output, a 7-octane increase would be equivalent to approximately a 12 per cent increase in power output. The curve is, therefore, a highly significant one in that it informs the engine designer that, due to deposition in the engine, he must design for an engine-fuel requirement of 7 octane numbers less than the commercially

(Continued on Page 112)

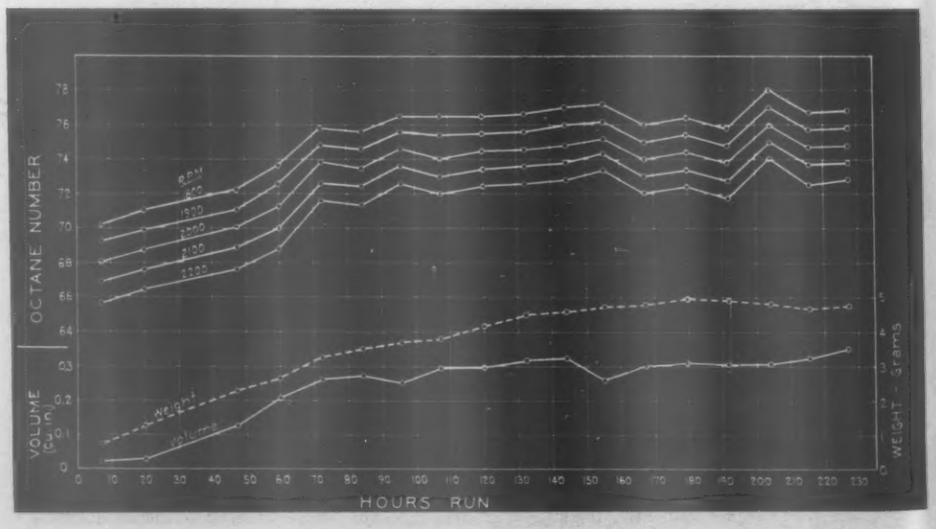


Fig. 12—Rise in octane requirement versus the weight of the deposition of carbon as weighed on the piston head and the total volume of the combustion chamber as taken by volume-oscillograph

Are We On the Threshold of a Petroleum Chemical Industry?

By W. L. NELSON

ON April 16, 1855, before the drilling of the Drake discovery well in Pennsylvania, Dr. Benjamin Sillman, Jr., of Yale University presented his "Report on the Rock Oil, or Petroleum, from Venango County, Pennsylvania," to several business men who were interested in developing the strange liquid found on the streams. This remarkable report when examined in full discloses with amazing foresight many of the developments which have since occurred in the petroleum industry. Thus in 1855 and almost continuously thereafter, chemists have been announcing that the time was at hand for utilizing petroleum as a base stock for a chemical industry.

Nevertheless, such developments have not taken place to a large extent except in the case of cracking or thermal decomposition which was developed on a commercial scale in about 1912. By this process, i.e. cracking, heavy petroleum oils are converted chemically into other oils, primarily gasoline, whereas all other major operations conducted in refineries have involved only physical changes such as the separation of materials by distillation, the removal of some impurities by solution in sulfuric acid, soda lye, etc. Of late such operations as the polymerization of cracking-still gases, the alkylation of light hydrocarbons, the carbonization of gas into carbon black etc., have been practiced, but in no case has the amount of oil (or gas) so altered by chemical processes amounted to more than 1 or 2 per cent of the total oil that has been processed. In a sense, some of the treating processes may be referred to as chemical processes but to an overwhelming degree the treating processes have been used to remove almost minute quantities of impurities and have not altered the main bulk of the oil in any wholesale way.

Chemical Industry Now Taking Form

Now for the first time our knowledge of chemical processes is permitting us to develop a true petroleum chemical industry. New chemical terms are being used by refiners each month. The most common chemical processes that are being applied to petroleum are (1) decomposition, (2) rearrangement, and (3) synthesis reactions or processes. Examples of the terms now in vogue for describing pure chemical reactions, are as follows:

1. *Decomposition* — (breaking into smaller parts).

A. Dehydrogenation—Removal of hydrogen to obtain types of hydrocarbons or materials that are chemically active and may therefore be used for the manufacture of other products.

$$C_4H_{10} = 2H_2 + C_4H_6$$
butane hydrogen butadiene (for synthetic rubber)

B. Carbonization — A complete decomposition often carried to complete breakdown into the elements carbon and hydrogen.

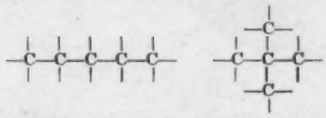
$$CH_4 = 2H_2 + C$$
methane hydrogen carbon (as carbon black)

C. Splitting — Partial decomposition whereby the material is split into two smaller parts but still not elemental.

$$C_{15}H_{32} = C_6H_{12} + C_9H_{20}$$
(part of gas oil) hexene nonane (as in cracked gasoline)

2. *Rearrangement*—(alteration of the fundamental arrangement of the atoms in the molecule).

A. Isomerization—Rearrangement without adding or removing anything from the original material.



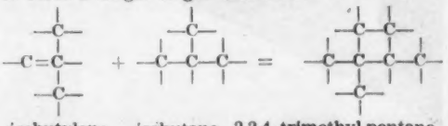
normal pentane (C_5H_{12}) neopentane (in high octane fuels)

B. Cyclization (and aromatization) — Hooking chain-like molecules into ring structures (often involves the loss of hydrogen).

$$C_7H_{16} = 4H_2 + C_7H_8$$
heptane hydrogen toluene (for T.N.T.)

3. *Synthesis*—(building up by connecting together).

A. Alkylation—Connection of unreactive paraffin and reactive (see 1.A.) olefin hydrocarbons to form a single larger molecule.



isobutylene isobutane 2,2,4-trimethyl pentane (100 octane aviation fuel)

(Continued on Page 126)

Shipping terminal of modern design and in service to supply the needs of markets located on water or reached by rail. Note the high proportion of pressure-tankage

New Ideas in

Segregated electrical equipment. In this area are (front left) 2,300-volt oil-immersed combination motor starters and (front right) low-voltage oil-immersed circuit breakers

By M. A. HYDE
Petroleum Industry Engineer,
Westinghouse Electric & Manufacturing Co.

Motor Control

MOTOR-CONTROL equipment for refinery service, by and large, is not strikingly different from that employed in other industries from the standpoint of electrical function, but physically it presents many differences in both electrical and mechanical construction, introduced by operating conditions peculiar to this industry. Out of these conditions have evolved many features of physical makeup and certain trends in application practice, all dictated by considerations of overall economy and service performance.

Operating Conditions

From the electrification standpoint, refinery service is characterized by the presence of one or more of the following operating conditions:

1. Explosion-hazardous atmospheres occur in certain areas.
2. Corrosive atmospheres are prevalent.
3. Large refineries commonly involve power concentrations, requiring special consideration of switchgear and motor control from the standpoint of power interrupting capacity.
4. Flexibility in apparatus is desirable to meet unpredictable changes in operating requirements.
5. A high degree of operating continuity is required.

These conditions, all too familiar to the refinery engineer, must be given due regard in the design and application of motor control if economical and reliable operation is to be attained.

Types of Enclosure

Considerations of hazardous atmosphere and corrosion place special emphasis upon the control housing. From the standpoint of enclosure, the solution to the specific control application problem may lie in one of several classifications:

1. General purpose.
2. Weather resisting.
3. Air-break for hazardous location.
4. Oil-immersed, for hazardous and for corrosive atmospheres.

General-purpose enclosures are of sheet steel, or in larger units panel or cubicle construction which should be dead front for operator protection. This is the most economical class where the control will not be subject to hazardous or corrosive atmospheres. Unfortunately, relatively few locations are free from one or both of these conditions. Such applications are frequently made in outlying locations, and sometimes in rooms separate from the process operations and ventilated with air known to be reliably safe.

Weather-resisting enclosures permit location without regard to shelter, and in the smaller sizes where tightly gasketed boxes are practicable some protection against corrosion is afforded.

The wide-spread extent of areas which are normally or occasionally hazardous and the desire to take every reasonable safety precaution in areas which may become hazardous due to accident or abnormal process operations, leads to the use, in the majority of refinery applications, of control equipment specially designed for service in hazardous atmospheres. Both the air-break and the oil-immersed enclosures are recognized

Fig. 1—Magnetic starters and fused safety switches control 440-volt motors. In general-purpose enclosures, they are suitable for nonhazardous, indoor location

for use in the hazardous atmospheres common in petroleum refineries, designated as Class I, Group D. (See National Electrical Code and Underwriters' Laboratories Standard for Industrial Control Equipment for Use in Hazardous Locations.) The air-break type in explosion-resisting enclosure has the obvious advantages of air instead of oil as the insulating medium, against which are the disadvantages of relative inaccessibility and limitation to the lower range of horsepower ratings by the difficulties inherent in providing adequate strength in an enclosure of reasonable size and weight.

The oil-immersed type is the most widely applicable, its mechanical limitations being only those incident to providing the necessary volume of oil to adequately submerge the active electrical parts and their connections. A distinct advantage of the oil-immersed form is effective protection of the submerged parts against corrosion.

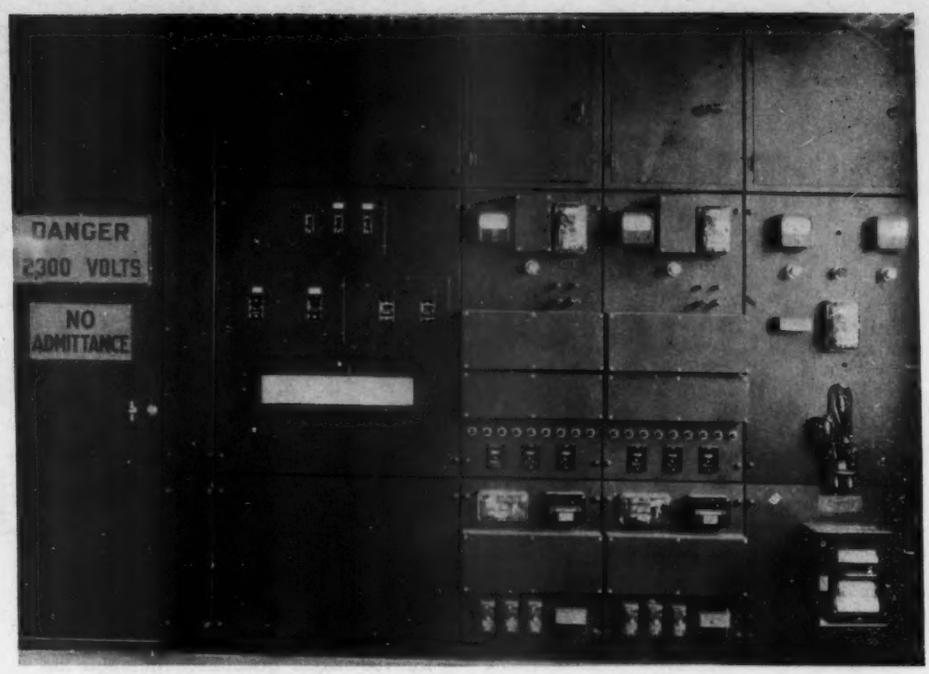


Fig. 2—Dead-front, open rear control panels for two 500 hp., 2,300-volt gasoline pump motors, incoming feeder and auxiliaries. This equipment is located in ventilated room separate from pump room

Trends in Refinery Motor-Control Practice

Each of the types of control discussed above has developed in accordance with certain trends which are worthy of discussion. One of these trends, evident particularly on circuits operating at 600 volts and below, is the increased use of circuit breakers on the power-supply side of individual motor starters to provide short circuit protection and disconnecting means. Among the advantages of the circuit breaker are:

1. Convenience of restoring service after a fault is cleared, minimum down time being an important consideration in process operations.

2. Simultaneous opening of all three conductors of a three-phase circuit, thus avoiding the possibility of a single-phase condition as may result from the independent functioning of only one of three independent overcurrent elements.

3. Reliability of protection. The overcurrent trip is precalibrated and is so assembled in the breaker as to prevent changes in setting or elimination of the overcurrent protection. Tripping of the breaker cannot be blocked from the breaker handle.

Fig. 3—Outdoor installation of weather-resisting 440-volt combination across-the-line starters

Circuit breakers of this type are available with combination thermal time-delay and instantaneous short-circuit trip, in general-purpose, weather-resisting, and explosion-resisting enclosures; and they are available with instantaneous short-circuit trip in oil-immersed enclosures.

For some time there has been increasing use of combination starters in which the disconnecting means is combined with the motor starter proper, into a single unit enclosure, effecting savings in space and installation expense. This type of starter, involving unit enclosures of greater volume, is less adapted to explosion-resisting than to oil-immersed construction particularly in the larger ratings. The combination oil-immersed starter has been built in ratings as high as 1,200 hp., 2,300 volts, although its most active use is in sizes 100 hp. and below at 440 volts.

In the design of oil-immersed combination starters the manufacturers have paid particular attention to the provision of interlocking safety features so as to minimize exposure of the maintenance personnel to live parts, and likewise to minimize the possibility of arcing or sparking when the enclosure is opened for inspection or maintenance work, which would represent a distinct hazard in explosive gas areas. Such starters are regularly built with a mechanical interlock requiring the disconnecting breaker to be opened before the oil tank can be lowered to expose the internal parts of the starter. The interlocking mechanism also prevents inadvertent reclosure of the breaker as long as the oil tank is removed from the normal operating position. Incoming leads, which remain live when the breaker is in the open position, are individually enclosed below the point where they are stripped to enter the oil.

Oil-Immersed Starters

The convenient form of construction for oil-immersed starters in the ratings most commonly used is one in which the internal parts and the enclosing tank are suspended from a top or head member which is built as a bracket to mount the complete starter on a wall or vertical structure surface. In early designs the location of the oil tank permitted direct entrance of conduit into the starter from top, sides or rear, but prevented entry from below except by the use of right-angle fittings running into the sides of the head. Recent designs accommodate the entry to conduit into the head directly from below, as well. This has been accomplished by extending the bracket construction of the head member so as to mount the tank sufficiently forward to provide clearance for conduit between the tank and the wall or mounting surface. The possibility of entering conduit directly from top, bottom, sides, or rear provides adaptability to various conduit layouts with minimum use of fittings. Units are regularly drilled and tapped for the entrance

(Continued on Page 119)

Performance Value Of High-Octane Aviation Gasolines

By G. A. C. LEAVER
Vacuum Oil Co., Brisbane, Australia

Why so much discussion about 100-octane gasoline? The question is in the mind of every one who has interested himself in the country's war program. In this article the most exact reasons are given for this country's preference for 100-octane gasoline. Although the story was presented months ago before the Institute of Automobile Engineers at Brisbane, Australia, it has lost none of its informative value and instead, time has helped to confirm its conclusions.

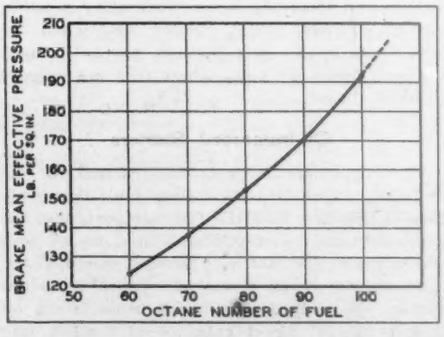
WHILE it must be conceded that considerable advances were being made in the search for suitable and reasonably priced high-octane fuels prior to the outbreak of war in September 1939, there is abundant evidence that the enormously increased market potentialities since then have greatly accelerated the quantity production of many desirable blending agents which had then only reached the laboratory stage in their production.

The basic fuel requirements of high-output aircraft engines, excluding gum, sulfur and other purity factors, can be simply expressed as:

High resistance to detonation.
Suitable volatility characteristics.
High calorific value.
Low specific gravity.

Dealing with these points in order we have:

High resistance to detonation.—No gain in economy or power output is effected by using a high-octane fuel in an engine designed to give maximum power at sea level on a fuel of a lower antiknock value. However, by changing either the compression ratio or supercharge ratio, advantage can be taken of fuels having high antiknock value. The approximate brake mean effective pressures (B.M.E.P.) which can be obtained from an air-cooled aircraft engine of average design, using fuels of different octane number, are indicated in Fig. 1.



"Intava World," Vol. 1, No. 1

Fig. 1—Power available from airplane engine burning petroleum fuels of various octane values

Reference to this graph shows that advantage to be gained by an increase in octane number is greater as the high end of the scale is reached, for instance, an increase from 70 to 80 octane gives an increased B.M.E.P. of 16 lb. per sq. in., whereas a similar increase of octane numbers from 90 to 100 gives an increase in B.M.E.P. of 23 lb. per sq. in. This tendency actually improves very rapidly at octane numbers exceeding 100, in fact the curve becomes an almost vertical line at 120 octane number (O.N.).

Detonation in car engines is not accompanied by immediate engine failure, but the effects of detonation in aircraft engines are quite disastrous, causing almost instantaneously a rapid temperature rise in cylinder heads and piston, with consequent fusing or seizure of the latter, or in some cases actual lifting of the cylinder heads off the barrels. A case of this nature came before the writer's notice some time ago. At that time two fuels were in use, 87 for takeoff and 80 for cruising above 5,000 ft. On one occasion a pilot failed to change from 80 to 87 when landing, and took off on 80 octane fuel. The effect of the enormous pressures developed during the detonating period caused five cylinder heads to be lifted partly off the barrels; in one the head had moved nearly ½ in. along the cylinder barrel.

Suitable volatility characteristics.—In Fig. 2 we have distillation curves of three fuels used in the Schneider trophy, and for comparison we also have a typical curve for a 100-octane aviation gasoline and an average standard-grade motor spirit. The 100-octane fuel has a particularly good curve, and, as would be expected, gives excellent performance in all respects.

Dealing with the motor-spirit curve, the presence of light fractions will be noted. These are undesirable in an aviation gasoline, as they raise the vapor pressure beyond the safe limits for aviation purposes. It will also be seen that the curve indicates a much higher proportion of heavy ends, which would increase fuel dilution figures if incorporated in an aviation gasoline.

Aviation Fuel Blends

Modern high-octane fuels are, in most cases, mixtures of special products such as isooctane, isopentane, isopropyl ether and neohexane with a basic aviation gasoline to obtain satisfactory distribution characteristics. In all cases TEL is added to increase further the octane rating.

Table 2 shows the relevant physical characteristics of some of the blending agents used today. It will be noted that, with the exception of No. 3, all these blending agents have high gross calorific value. It is probably unfortunate that the exception, No. 3, has everything else in its favor.

While dealing with physical characteristics, sight must not be lost of another important item, that of vapor pressure. Much trouble is caused by vapor lock in automobile and truck fuel systems. The tendency of fuel to gasify becomes more pronounced as altitude is increased, and this fact must be taken into consideration when blending aviation gasoline which will be called upon to operate at high altitudes, as is the case with all modern aircraft, either civil or military. Motor petrols have an average Reid vapor pressure of about 9 lb., and even if they possessed octane ratings sufficiently high, would be quite unsuitable for aviation purposes. Reid pressures up to 7 lb. are the maximum that can be successfully used in aviation gasolines.

High calorific value.—This is a very desirable characteristic, which can be coupled with the following item:

Low specific gravity.—A combination of the two characteristics, high calorific value and low specific gravity, assists materially in increasing the range or load capacity of the machine, a feature which is assuming importance in the present war.

The main physical characteristics of ethanol (synthetic ethyl alcohol) show reasons for its

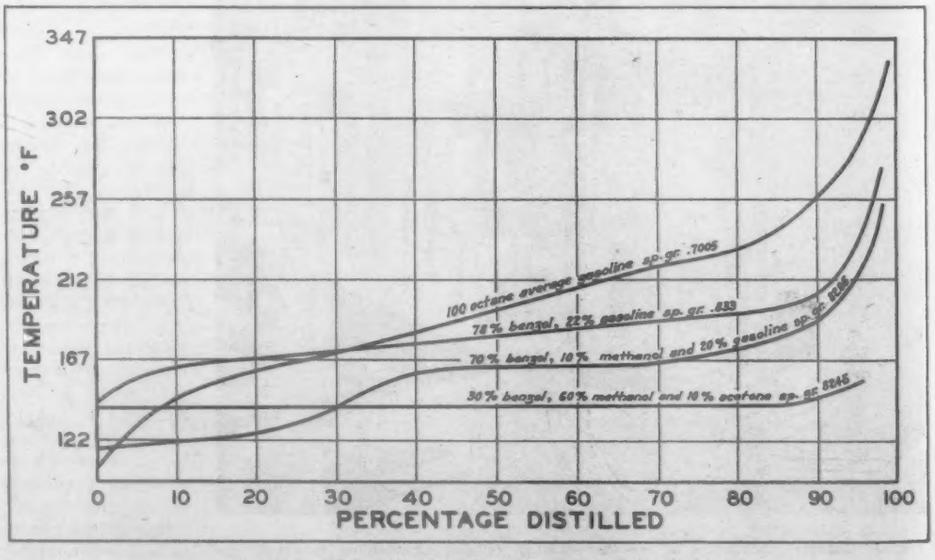


Fig. 2—Distillation characteristics of various aviation fuels

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elimination as an aviation fuel. It has a high specific gravity, 0.792, with a low calorific value, 12,700 gross B.t.u. lb., and these two disabilities would lead to a high fuel consumption of a heavy fuel, thus reducing the range of the machine considerably, even if the engine were specially designed to use such fuel.

Modern aviation gasolines have a calorific value of between 19,500 and 20,000 gross B.t.u. lb., and specific gravities in many cases as low as 0.700. Considered this way we find that the aviation gasoline contains 40 per cent more B.t.u. per gallon than ethyl alcohol, and, taking into consideration the thermal efficiency of existing engines, one would be optimistic indeed who would forecast developments which would permit a design burning alcohol to make up this 40 per cent leeway.

Of the methods used for producing high-octane gasolines, polymerization alone will be dealt with.

In a general way we can say that polymerization consists of the combination of two or more molecules of the same substance to form a larger molecule, which is called the polymerization product, or polymeride. As the polymeride consists of the same atoms as the original substance but multiplied by two or more, it has the same chemical composition as the original product. By strict definition the term polymerization should only be applied to such reactions of the type mentioned which can easily be converted into the original simpler compound. In cases where this is not readily accomplished the process of multiplying the simpler compound to make the more complex compound is termed condensation. However, we can ignore this distinction, as it will facilitate our understanding of the subject.

One of the earliest examples of polymerization is the conversion of acetylene into benzene by Berthelot. This is an example of a gas having a composition of 92.4 per cent of carbon and 7.6 per cent of hydrogen by weight being converted into a liquid with the same proportion of carbon and hydrogen. The molecule of the gas, acetylene, contains two atoms of carbon and two atoms of hydrogen, and is represented by the formula C_2H_2, while the molecule of benzene contains six atoms of carbon combined with six atoms of hydrogen and represented as C_6H_6. This chemical change can be represented by the equation:

$$3C_2H_2 = C_6H_6$$

In order that a chemical compound may be able to form polymerides it must be of a reactive type, so that it readily combines with other chemical substances to form new compounds or with itself to form polymerides. A chemical compound which is of the reactive type can be said to have spare capacity for combining with other substances, and it takes the opportunity of using up this spare capacity when the conditions are suitable.

The valency of the carbon atom is shown very clearly in the hydrocarbons met with in the petrol industry. In natural gas, the simplest hydrocarbon is methane CH. The next gas of this series is ethane, C_2H_6, and this is followed by propane, C_3H_8. If these gases are represented by the usual diagrams, it will be seen that in each case the carbon atoms are tetravalent (Fig. 3a.)

One can consider that the carbon atom has four bonds, each of which is attached to a hydrogen atom or another carbon atom, each of the four bonds of the carbon atoms in the above series being fully occupied. The hydrocarbons in this series are therefore called "saturated" hydrocarbons.

Another series of hydrocarbons is that found in the gases obtained from cracking operations. The simplest gas in this series is ethylene, C_2H_4, and the next gas in this series is propylene, C_3H_6. The

TABLE 1 — RELATIVE PERFORMANCE — KOOLHOVEN Fk59—TWO-SEATER RECONNAISSANCE BOMBER. BRISTOL MERCURY XV

("Flight" V37, N1626, P180. 22-2-40)

Aircraft—	87 octane	100 octane
Max. speed at 2,750 r.p.m.	236 m.p.h.	260 m.p.h.
Altitude for max. speed	15,700 ft.	17,300 ft.
Cruising at 60% max. power	192 m.p.h.	211 m.p.h.
At height of	15,700 ft.	17,300 ft.
Rate of climb:		
At sea level	1,490 ft./min.	2,180 ft./min.
At 6,500 ft.	1,630 ft./min.	2,360 ft./min.
At 13,000 ft.	1,730 ft./min.	2,540 ft./min.
At 19,500 ft.	1,220 ft./min.	2,050 ft./min.
Time of climb:		
To 6,500 ft.	4.2 min.	2.9 min.
To 13,000 ft.	8.0 min.	5.6 min.
To 19,500 ft.	12.3 min.	8.3 min.
To 26,000 ft.	19.4 min.	12.2 min.
Service ceiling	31,800 ft.	35,700 ft.
Absolute ceiling	32,800 ft.	36,700 ft.
Maximum engine output	830 hp.	1,050 hp.
Maximum power height	14,450 ft.	15,580 ft.

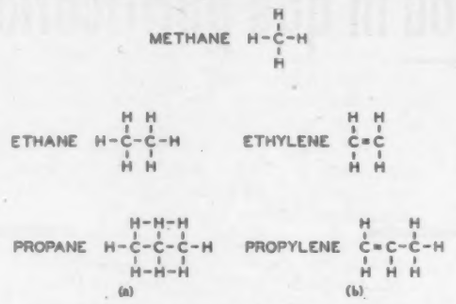

Fig. 3—Saturated and simple straight-chain hydrocarbons and their unsaturated derivatives resulting from dehydrogenation

way the carbon valencies are used in these compounds is shown in Fig. 3b.

It will be seen that in this series of gases, known as the olefins, two of the carbon atoms are joined together by a double bond instead of the single bond. One of the bonds in each of the two carbon atoms can therefore be considered as a spare bond, available for combining with other atoms under suitable conditions. The hydrocarbons containing these double bonds are said to be "unsaturated," and they are more reactive than the saturated hydrocarbons found in natural gas and known as the paraffin hydrocarbons.

These unsaturated hydrocarbons are the type which polymerize under suitable conditions, whereas the saturated hydrocarbons will not polymerize unless they are first converted into unsaturated hydrocarbons by suitable means.

The polymerization of unsaturated hydrocarbons is a phenomenon which is quite familiar in the treatment of cracked gasoline with sulfuric acid, when some of the lighter unsaturated hydrocarbons are polymerized into heavier hydrocarbons of higher boiling point, resulting in a substantial increase in the higher-boiling fractions of the cracked gasoline after acid treatment.

The method of treating cracked gasoline in the vapor phase with clay depends on the polymerization of the more reactive hydrocarbons, which form polymerides or polymers of high boiling point and are separated by fractionation from the treated gasoline.

In the early example of polymerization of acetylene into benzene, the reaction was carried out by heating the acetylene in a closed tube so that the acetylene gas was subjected to moderately high temperature. This is one method of carrying out the polymerization of unsaturated hydrocarbon gases. The other examples of polymerization given above involve the use of a catalyst.

Dustan and Wheeler, over a period from 1922 onwards, found that if the paraffin or unsaturated hydrocarbon gases, such as methane, ethane, etc., were heated to very high temperatures (1,470° F. to 1,920° F.), they obtained fair yields of liquid products containing chiefly aromatic hydrocarbons. If the paraffin hydrocarbon gases were heated to lower temperatures, so as to get ordinary vapor-phase cracking conditions, these hydrocarbons are converted into unsaturated hydrocarbons or olefins. These olefins being unsaturated and very reactive, easily polymerize when heated to a much lower temperature, not exceeding 1,020° F., into hydrocarbons more complex than the olefin gases, and the products so formed are liquids.

The conversion of paraffin hydrocarbons at high temperatures into aromatic hydrocarbons and into olefin hydrocarbons at somewhat lower temperature is referred to as "pyrolysis," and this is the reaction known in the petroleum industry as "cracking." The pyrolysis of natural-gas producing olefins really amounts to the vapor-phase cracking of natural gas, which yields a gas similar to that obtained from the vapor-phase cracking of petroleum fractions. These fractions are liquid under normal atmospheric conditions of temperature and pressure.

By the methods which we have discussed we can convert either natural gas or cracking-plant gas into liquid products, so that we have a means of converting a material which is used as a fuel into a more valuable product, which can be used as motor fuel. It is found that gasoline produced in this way has extremely high antiknock values, so that the importance of polymerization processes is quite obvious.

It is seen, therefore, that the hydrocarbon structure can be changed, and the effect of these changes upon the octane number of the three pentanes will now be examined. (Fig. 4.) It will be noted that the three products each have the same

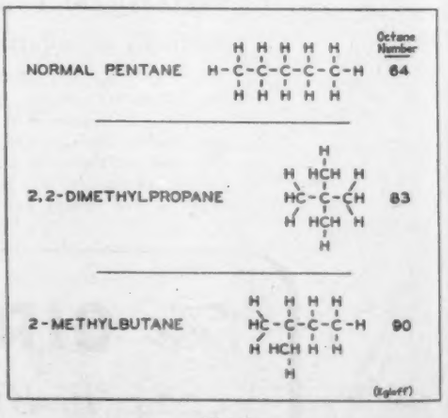

Fig. 4

TABLE 2

Fuel type—	Reid V.P. at 100° F.	Sp. gr. at 60° F.	Gross B.t.u. per lb.	Oct. No.	Blend Oct. No. value	Boiling point °F.
No. 1. C.p. isooctane (2,2,4-trimethyl pentane)	2.2	.696	20,500	100	....	211
No. 2. Com. isooctane	1.3/2.5	.70/.72	20,500	96.5	V. good	206/245
No. 3. Diisopropylether	5.3	.729	16,900	93	V. good	154
No. 4. Neohexane (2,2-dimethylbutane	9.5	.654	20,700	95	Good	122
No. 5. Isopentane	20.4	.625	20,800	90	V. good	82
No. 6. 2,2,3-trimethylbutane	3.3	.694	20,600	125	125	178

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Air, Fuel Cleaners—Clean regularly.

Oil, Diesel Fuel (on Diesel models) Filters—Clean regularly; replace filter elements every 100-120 hours of operation.

Oil Screen—Clean whenever oil pan is removed.

Gasoline Strainer—Clean at least once a month.

Oil Change—Every 100-120 hours of operation.

Carburetor—Remove, clean fuel screen occasionally; check fuel bowl cover screws regularly—keep them tight.

Magneto—See instructions in operator's manual on lubrication, distributor, adjusting points, timing, etc.

Cooling System—Always use clean water; clean regularly; adjust fan belt regularly for correct tension; replace fan belt when badly worn; keep water pump packing nut tight enough to stop leaks; install new packing when needed.

Spark Plugs—Remove, inspect, clean every 200-300 hours of operation.

Clutch—Inspect regularly to maintain correct clearance between throw-out bearing and release fingers.

Storing, Housing—Keep engine in dry, protected place when not in use.

Read, study operator's manual for other money-saving suggestions.

MAINTENANCE

Sleeves, Pistons—If and when replacement is needed, matched sets can be quickly, easily installed.

Fuel Injection Pump (on Diesel engines)—Entire unit can be replaced easily. Always use clean fuel oil.

Crankshaft Bearings—Replace when needed; no fitting or reaming necessary.

Valve Grinding—As needed.

THE WEBSTER ENGINEERING CO.
QUALITY EFFICIENCY SERVICE with SPEED

Keep 'em on Stream

WASHINGTON, D. C., Feb. 23—To multiply the Industry's Capacity to manufacture high-octane gasoline for war planes to as much as 200,000 bbl. per day . . . . to obtain the maximum production of the components of aviation gasoline, as well as rubber and other synthetic products, and to stimulate the production of aviation lubricants.—excerpts from The Oil and Gas Journal, March 5, 1942.

The increased use of gasoline and lubricants by our armed forces means that new refining units must be built and the stepping-up of production in existing units.

Each one of us must devote all our time and the facilities at our command to produce the materials necessary to win. The gas and oil burners required on these refinery units are a very small part of the entire project, but are vital to its operation. These burners must be properly designed to give the greatest out-put. Also they must be available in the shortest possible time.

The Webster Engineering Company has been building gas and oil burners, for the oil industry, for 15 years and has kept pace with the improvement necessary for maximum out-put. They are also in a position to manufacture and deliver on schedule.

Our engineering department is thoroughly capable of helping you solve your problems and to design special equipment to meet special conditions.

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Division of SURFACE COMBUSTION - - - - - TOLEDO, OHIO

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Eastern and Export Representatives:
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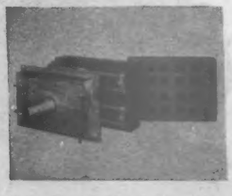
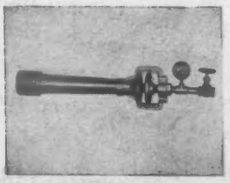
Webster Series R, Combination Gas and Oil Burner



Webster Radiant, low pressure, Gas Burner.

Webster Series 200, Radiant Gas or Combination Burner.



Webster Series VI, premixing, Gas Burner.

Webster Series 900, premixing, Gas Burner.

number of carbon atoms, in this case 5, and 12 hydrogen atoms, yet the arrangement of the atoms in the molecule have a marked effect on the resultant octane number.

Fig. 5 deals with octane and isooctane. Both

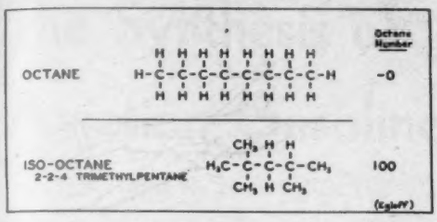


Fig. 5—Wide difference in detonating value of hydrocarbons containing the same number of hydrogen and carbon atoms but arranged in different molecular structure patterns

octane and isooctane have the same chemical formula of C_8H_{18}, yet the octane number is changed from less than zero to 100 by this rearrangement.

Having gone so far, it is of interest to consider a list of the paraffin series of hydrocarbons, from methane to isododecane. Fig. 6 supplies further

	Symbol	Octane Number
METHANE	CH_4	125 a
ETHANE	C_2H_6	125 a
PROPANE	C_3H_8	125 a
BUTANE	C_4H_{10}	91
ISOBUTANE	C_4H_{10}	99
PENTANE	C_5H_{12}	64
2-2, DIMETHYLPROPANE	C_5H_{12}	83
2, METHYLBUTANE - ISOPENTANE	C_5H_{12}	90
HEXANE	C_6H_{14}	59
2-3, DIMETHYLBUTANE	C_6H_{14}	95
HEPTANE	C_7H_{16}	0
OCTANE	C_8H_{18}	-0
ISO-OCTANE 2-2-4, TRIMETHYLPENTANE	C_8H_{18}	100
NONANE	C_9H_{20}	-28
ISODECANE	$C_{10}H_{22}$	93
ISODODECANE	$C_{12}H_{26}$	100

a Estimated

Fig. 6—Octane numbers of petroleum hydrocarbons in the lower portion of the range

evidence of what is possible in the matter of increasing octane number by juggling with hydrogen and carbon atoms.

Earlier in this paper certain blending agents were referred to which make possible the manufacture of high octane fuels with reasonable concentrations of TEL.

Obtaining Blending Agents

The methods of obtaining some of these blending agents will now be outlined briefly.

Isopentane.—This possesses excellent stability, and its high lead susceptibility makes it an all-round desirable constituent for 100-octane number gasolines.

Isopropyl ether.—This blending agent has a clear octane number of 98 and a high lead response. It contains 12 per cent of oxygen, but will not form peroxides in storage if properly inhibited by suitable agents. Blended with a base aviation gasoline of 73 octane with 3 cc. TEL gives a fuel of more than 100 octane number.

Neohexane.—Neohexane is manufactured by a process known technically as thermal alkylation, and has high octane number, 95, high lead susceptibility and comparatively low boiling point, 122° F. of neohexane, makes it a very desirable constituent of high octane aviation gasoline.

The foregoing outline gives some idea of the care which must be exercised in the production of some blending agents. The next thing to consider is the potential supply of raw materials, and in this respect the picture is a very reassuring one.

Dr. Gustav Egloff, in April 1940, stated that cracking as practiced in the manufacture of motor spirit, produces 350,000 million cubic feet of hydrocarbon gases per annum, which are converted partly into chemical compounds and partly into polymer gasoline, isooctane, neohexane and other products with octane number of 90—100 and high lead susceptibility. He also gives the following figures for aviation gasolines, which can be synthesized from gases obtained in cracking, and in catalytic dehydrogenation:

Process—	Possible output (million cu. ft.)	Oct. No.
Dehydrogenation, plus polymerization	2,180	96
Hydrogenation of butanes and butylenes	1,095	85
Thermal alkylation of neohexane, isobutane and ethylene	1,290	95
Sulfuric acid alkylation of isobutane and butylenes	1,713	93
Total	6,278	

In addition to refinery gases, there are 350,000 million cubic feet of propane and butanes available from natural gas. Catalytic dehydrogenation of these hydrocarbons over a catalyst such as blended aluminum and chromic oxide yields over 95 per cent of ethylene, propylene and butylenes, which in turn can be made blending agents.

●

One-Man Fire-Fighting Equipment in Refinery

FIRE hydrants, with 150 ft. of 1½-in. hose and a nozzle attached, are enclosed as illustrated at a Pennsylvania refinery. A spray nozzle is attached since this type would be the most likely to be used though a straight-tip nozzle is also available if needed. The nozzles are equipped with shutoff valves so that the pressure of the water will help unkink the hose as it is dragged to the fire. The hose is folded on the platform so that it may be removed without any difficulty. A wrench is in place on the hydrant valve at all times and a smaller wrench for the hose couplings is kept in each booth. The advantage of this installation is that it enables one man to attack a fire alone. Thus he may be able to extinguish fires before they spread or may be able to control them until assistance arrives.

A typical booth is shown in Fig. 1. These booths are located at strategic points in the refinery. It is noted there are separate valves for each hose coupling. These make it possible to attach other hose without shutting off the water entirely.

The couplings for 1½-in. hose are shown in the foreground. One serves as a permanent attachment for the 150-ft. hose ready for immediate use. The other is for the rolled hose, shown in the background, to which an applicator is attached. The applicator, shown suspended above the ladder in Fig. 2, consists of a 10-ft. length of pipe and a 3-ft. curved tip. It is used when necessary to direct the water against a point well above ground level or in a confined space. If needed, an additional 10-ft. length may be added to the applicator, giving it a total length of 23 ft.

Ladders, such as that shown in this picture, are also located at convenient points throughout the refinery. They were purchased from the local fire department.

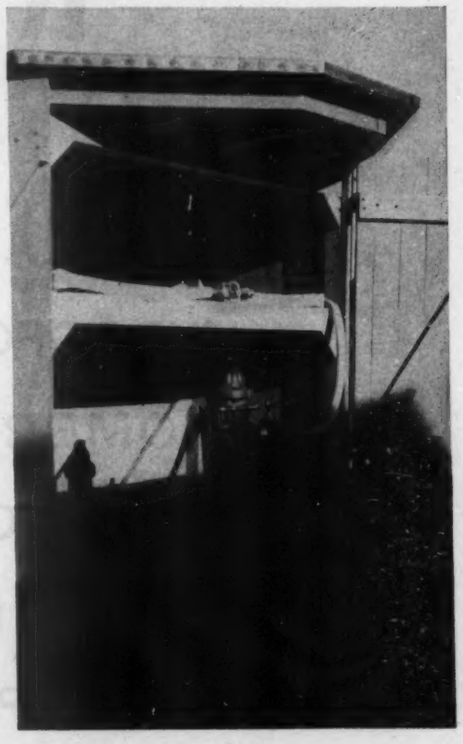


Fig. 1—Typical hydrant booth with hose storage

Fig. 2—Loading rack showing pipe line and hose applicator suspended above ladder in foreground

KEEP 'EM FLYING WITH

100 octane

MODERN aviation gasoline by PROCESSES

INCLUDING:

...ALKYLATION
...HYDROFORMING
...ISOMERIZATION
...HYDROGENATION
...POLYMERIZATION
...DESULPHURIZATION
...CATALYTIC CRACKING
...PRECISE FRACTIONATION

engineered, designed, fabricated and constructed by FOSTER WHEELER

Foster Wheeler Corporation, 165 Broadway, New York, N. Y.

FOSTER FW WHEELER

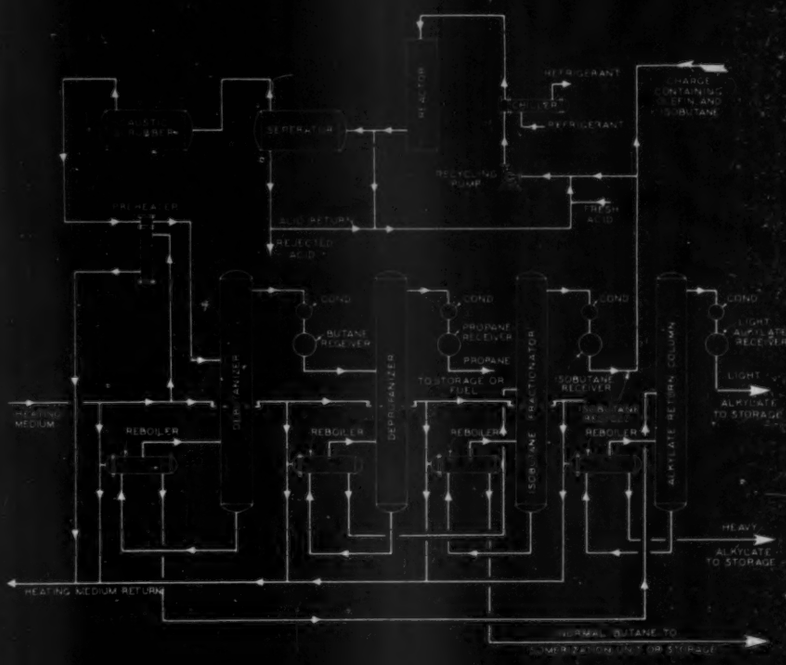
Flow Charts for The Synthesis of Aviation Gasoline

(See Pages 95, 98, 103, 106, 111)

SULFURIC ACID ALKYLATION:

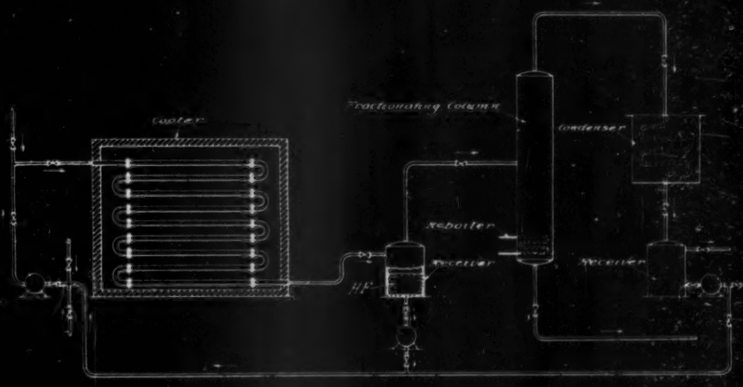
Alkylation, for the purpose of making 100-octane gasoline, means combining butylenes ($C_4 H_8$) with isobutane ($C_4 H_{10}$) to produce saturated isoparaffins, especially isooctane ($C_8 H_{18}$). The reaction is exothermic and cooling is needed to control it. The reaction temperature is in the range of 90° to 120° F.

The sulfuric acid used to effect the union is held at 90 per cent strength by the addition of stronger acid and with replacement in time. Obviously, one of the limitations in the extended use of this process is the supply of isobutane which, in turn, accounts for the installation of isomerization plants. The latter convert the normal butane to the isomer used in alkylation.



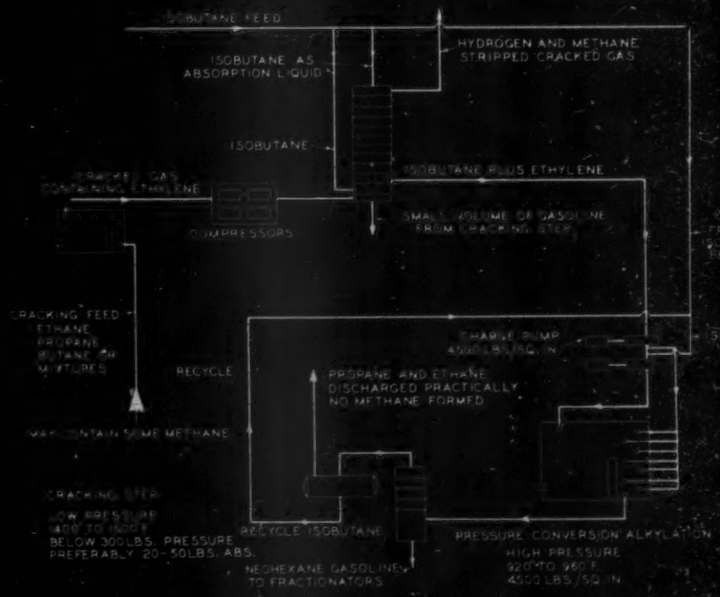
HYDROFLUORIC ACID ALKYLATION:

This process is relatively new and, according to the patent, comprises a process for the alkylation of isoparaffin hydrocarbons with mono-olefinic hydrocarbons in the presence of liquid hydrogen fluoride under controlled conditions. The anhydrous hydrogen fluoride catalyst is a liquid boiling at about 68° F. In operation, the mixture of hydrogen fluoride and an isoparaffin are continuously agitated while an olefin and isoparaffin mixture are introduced into the agitated body. The process includes the alternative of using hydrogen fluoride generated in situ by the reaction of strong mineral acids on fluorides.



THERMAL ALKYLATION:

To produce neohexane, a thermal alkylation of isobutane and ethene is effected. The reaction occurs at about 950° F. and at pressures between 3,000 and 5,000 p.s.i. These high pressures are used to retard cracking tendencies. The olefin concentration is kept low with respect to that of isobutane so that polymerization may be suppressed. In this manner, a uniform product, neohexane, is formed by the combination of one molecule of ethylene with one of isobutane. The product has an octane value of 94 and is very susceptible to tetraethyl lead. It has a volatility suitable for blending with isopentanes, alkylates, isooctanes or naphtha-base stocks to be used as aviation or automotive fuels.

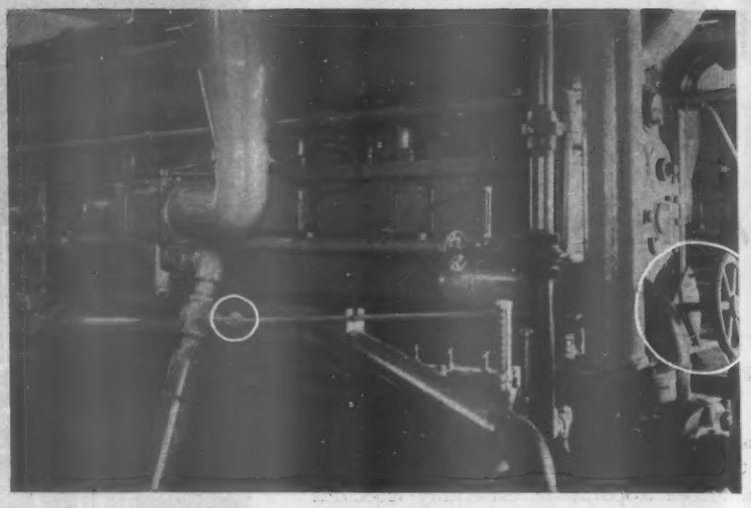

ISOBUTANE FEED
ISOBUTANE AS ABSORPTION LIQUID
HYDROGEN AND METHANE STRIPPED CRACKED GAS
ISOBUTANE
ISOBUTANE PLUS ETHYLENE
SMALL VOLUME OF GASOLINE FROM CRACKING STEP
COMPRESSORS
FRESH ISOBUTANE FEED
CRACKING FEED ETHANE PROPANE BUTANE OR MIXTURES
RECYCLE
PROPANE AND ETHANE DISCHARGED PRACTICALLY NO METHANE FORMED
CRACKING STEP
RECYCLE ISOBUTANE
NEOHEXANE GASOLINES TO FRACTIONATORS
PRESSURE CONVERSION ALKYLATION HIGH PRESSURE 920°TO 960°F 4500 LBS/SQ IN

Refinery IDEAS

. . . that save $ $ $

Portable Light Stand

Refinery repairs sometimes must be made hastily and at night. The problem of supplying the light is handled at one plant by providing a portable light stand made of welded sucker rods. The spotlight shown here was purchased with a small stand and this in turn was bolted to the larger stand. By means of a simple reinforcement the stand was made more serviceable under all weather conditions. Note also that the lower ends of the stand are swedged down to a point in order to promote stability.



Gas Supply to Engine Adjusted by Extension to Throttle Valve

In a line of large, gas-driven engines the supply of gas to each is conveniently adjusted by means of an extension on the stem of the throttle valve. This extension on one engine can be plainly seen in the picture. The wheel mounted at the one end serves as the adjusting medium and can be turned to a predetermined point. This can be ascertained by previous operations. The desired position can be reached by adjusting the valve so that the welded arm on the stem is over the mark on the stationary scale. This extension works through a double joint to give flexibility to the assembly.

Air Impact Hammer Set In Movable Cradle

This device is used for lifting an air impact hammer for tightening screw jacks on return bends. It is easy to operate, and being mounted on rollers can be moved about easily. The air hammer proper is set in a cradle inside the slotted pipe. The slots accommodate the hammer handles. The cradle is mounted on one end of a lever and is raised or lowered by the operator. The equipment on the floor is an oiler but has no connection with the device for lifting the hammer.

Sand Trap Placed in Water Line at Outlet of Well

A 10-ft. section of 16-in. casing welded closed at both ends and fitted with two flanged connections at each end is being used in one plant to catch any sand brought up with the water coming from a water well. No baffles are used inside the drum, the rate of flow through the drum being slow enough to permit the sand to drop out of suspension. Any accumulation can be readily removed from the drum by opening either or both of the lower blank flanges on the ends.

Hats off!! to

The CHICAGO CORPORATION

on completion of the large addition to the WARDNER plant.

We are proud of our part in this work, which covers

1st. The Original Plant. This was the first large Distillate Recovery and Pressure Maintenance Plant in the Industry.

2nd. Changes and Additions. These doubled the capacity of the Plant to 120 mm/cf per day, and converted it to the Absorption Process.

All of the work was done by us on a Turn-key basis, including design, furnishing all materials, fabrication of equipment in our own Shops and field installation with our own construction forces.

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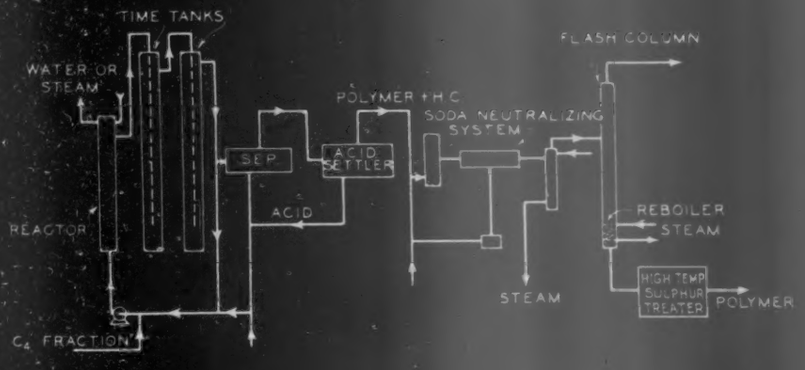
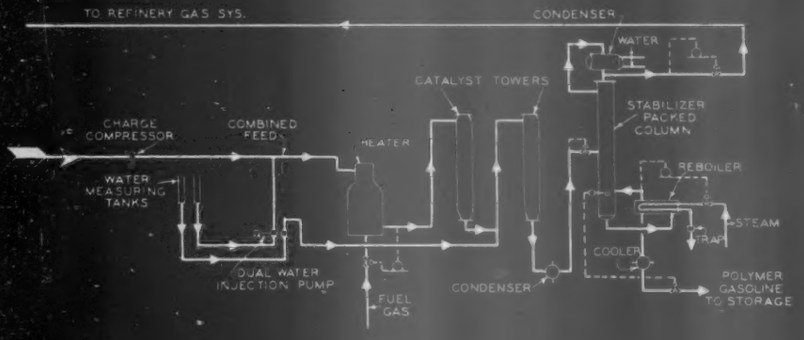
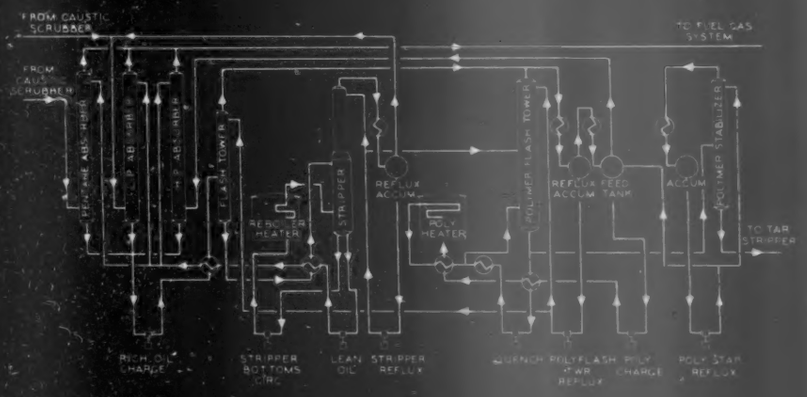
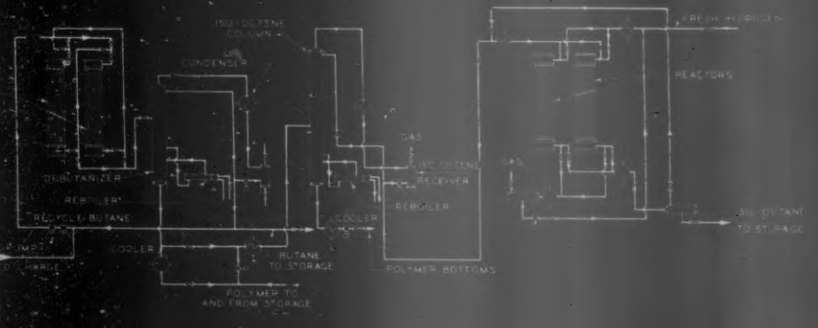








Flow Charts for The Synthesis of Aviation Gasoline

(See Pages 95, 98, 103, 106, 111)

CATALYTIC POLYMERIZATION:

Here a simple and effective means for combining the olefins of cracked gases is shown. Since the olefins are products of thermal cracking the procedure fits especially well into the ordinary refining routine.

Years ago, Ipatieff showed that olefins contained in cracked gases could be polymerized commercially into gasoline of 80-octane number in the presence of "solid phosphoric acid" at 200 p.s.i. and at 392° F.

CATALYTIC POLYMERIZATION:

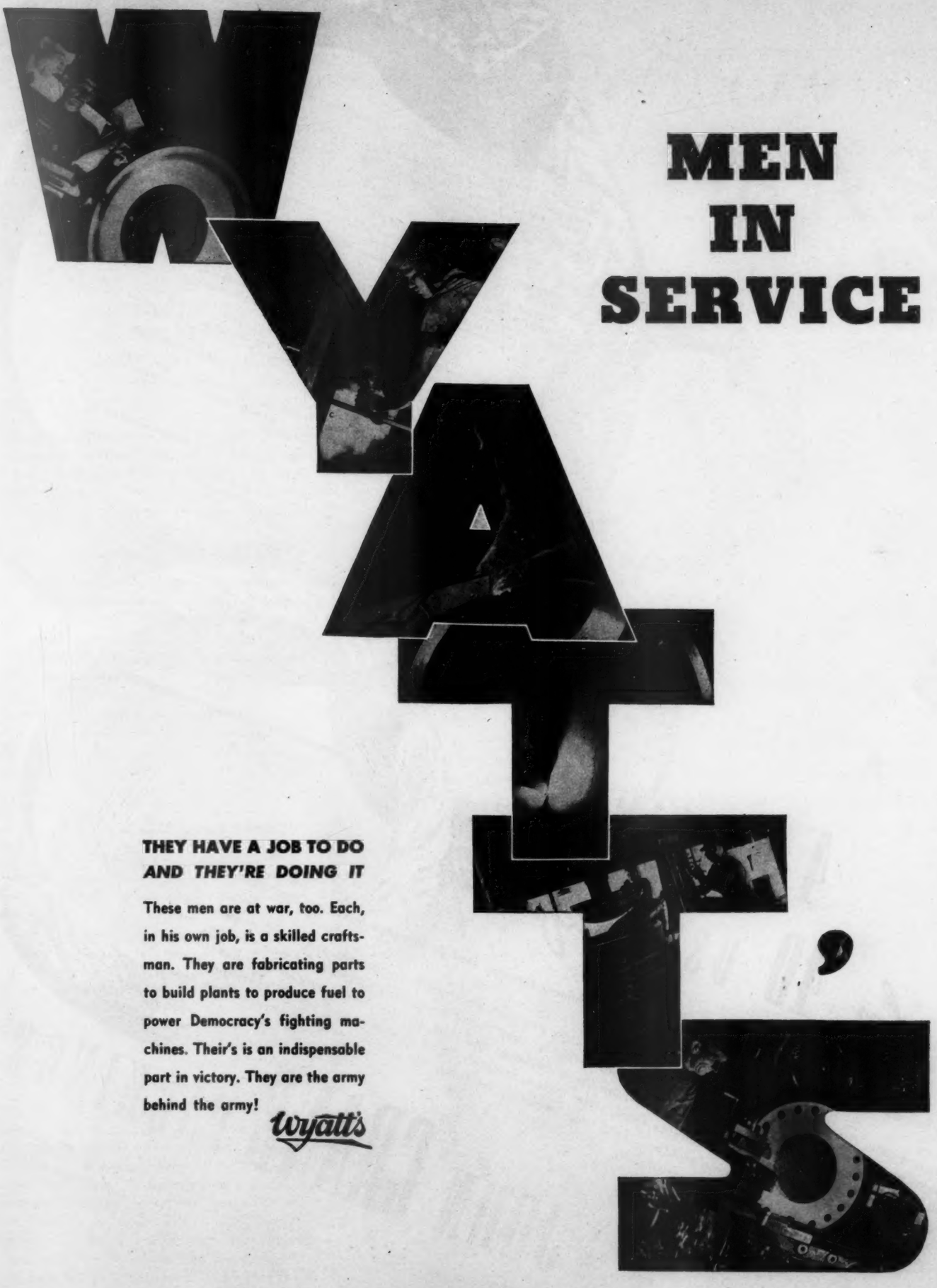
Shown in flow-chart form here, the polymerization procedure is recognized as that of the "hot" acid process. In it, the C_4 fraction, containing butanes and butenes and coming largely from thermal cracking operations, are first contacted with sulfuric acid until the butenes are polymerized. The reaction is exothermic so cooling is necessary. The desired temperature is about 185° F. The oil remains in contact with the acid for about 15 minutes, after which the polymer is neutralized with caustic soda.

THERMAL POLYMERIZATION:

The union of C_3 and C_4 hydrocarbons under relatively high temperature and pressures to produce hydrocarbons in the gasoline boiling range and without the use of catalysts, is known as thermal polymerization. Because of the high temperatures employed (about 1,000° F.) and under pressures of 1,000 to 3,000 p.s.i., most authorities agree that partial cracking takes place as well as polymerization.

POLYMERIZATION—ISOOCTANE PROCESS:

Polymerization of butenes to isooctenes is accomplished by passing a caustic-washed charge of the raw stock over "solid phosphoric acid" at a temperature about 300° F. and under a pressure of about 700 p.s.i. The isooctenes which form have an octane number of 84. After hydrogenation to isooctanes, the mixture has a rating of about 95. Hydrogenation is carried out at a pressure of about 75 p.s.i. and at a temperature of about 300° F. Close control of this temperature, during hydrogenation, is necessary for the reaction is exothermic.



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These men are at war, too. Each, in his own job, is a skilled craftsman. They are fabricating parts to build plants to produce fuel to power Democracy's fighting machines. Their's is an indispensable part in victory. They are the army behind the army!

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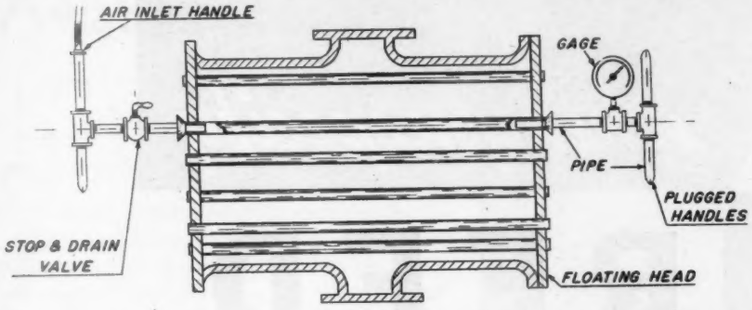
Refinery IDEAS ... that save $ $ $

Compressed Air Tests Heat-Exchanger Tubes

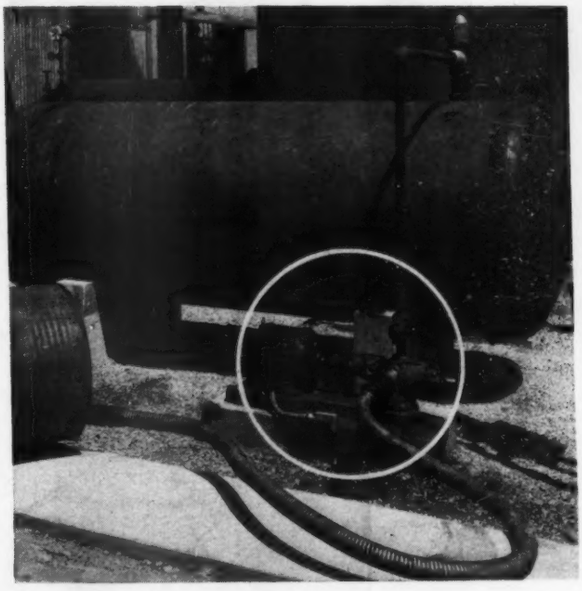
The tubes inside heat exchangers sometimes develop hair-like cracks which cannot be readily seen even after the faulty tube is removed. It therefore becomes advantageous to devise a rather delicate and yet practicable means for locating such tubes in place. The problem has been solved at one refinery by assembling the equipment shown in the drawing. It consists essentially of an air-supply line, stop and



drain cock, a pressure gage and two short nipples to each of which a beveled lead seal is tightly held. To test the tube the nipples of the test apparatus are inserted in opposite ends of the tube and the beveled edges of the seals are brought up tightly against the ends of the tube. An arm in the shape of a U and extending from one end of the tube to the other holds the two nipples in place. After the seal is effected, air is allowed to flow into the tube and the gage reading is noted as soon as the pressure becomes stabilized. Then the cock is closed. If the pressure declines, the tube is known to have a leak and is removed. This testing apparatus is light enough to be easily carried about.

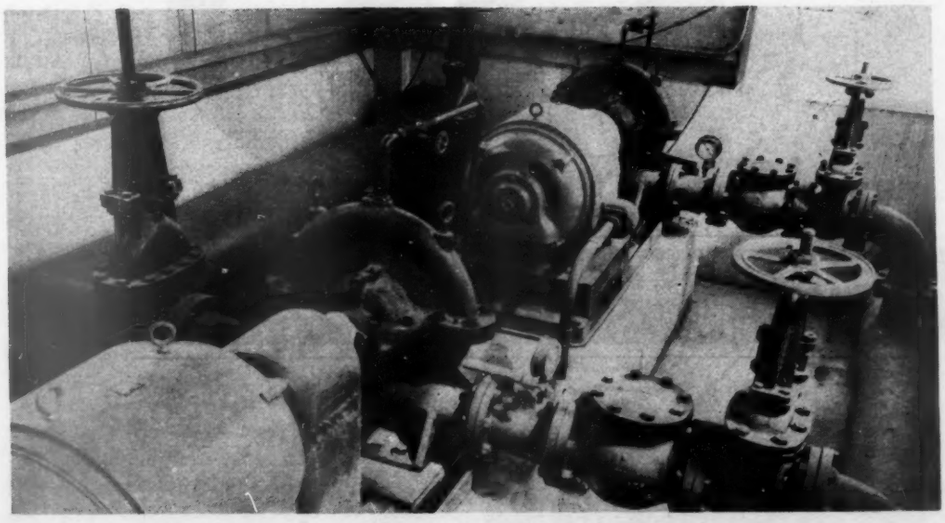
Hand-Wheel Used To Operate Stack Draft

Recognizing the need to have a remote control on the stack draft, one refiner has erected a small windlass in the plant yard and away from the stills and to which he has run a flexible line from the damper in the stack. In case of fire the damper can be thus quickly closed.



Electrically Driven Centrifugal Pump Takes Lubricant From Drum to Storage

Utilizing a small electric-motor-driven centrifugal pump equipped to take a flexible hose, this refiner is able to quickly and safely transfer the lubricant from the 55-gal. drum in which it comes to the stationary storage tank in the plant and serving the compressors. The transfer can be made quickly and pressure is retained on large tank to hold it in service during the transfer.



Eliminate Air-Pockets By Taking Suction At Top

Hydrocarbon gases or air which might tend to accumulate in the 20-in. suction line entering the pump house will be drawn off continuously when using the assembly shown here. The design provides for welding the 8-in. pump lines into the header. The top of the suction line is tangent to the top of the header. From this short length of 8-in. the design calls for an eccentric reducer thereby providing a straight-line flow from the top of the header to the bottom of the centrifugal pump.

You get the same "REED DEPENDABILITY"

A STRONG-SAFE WELD

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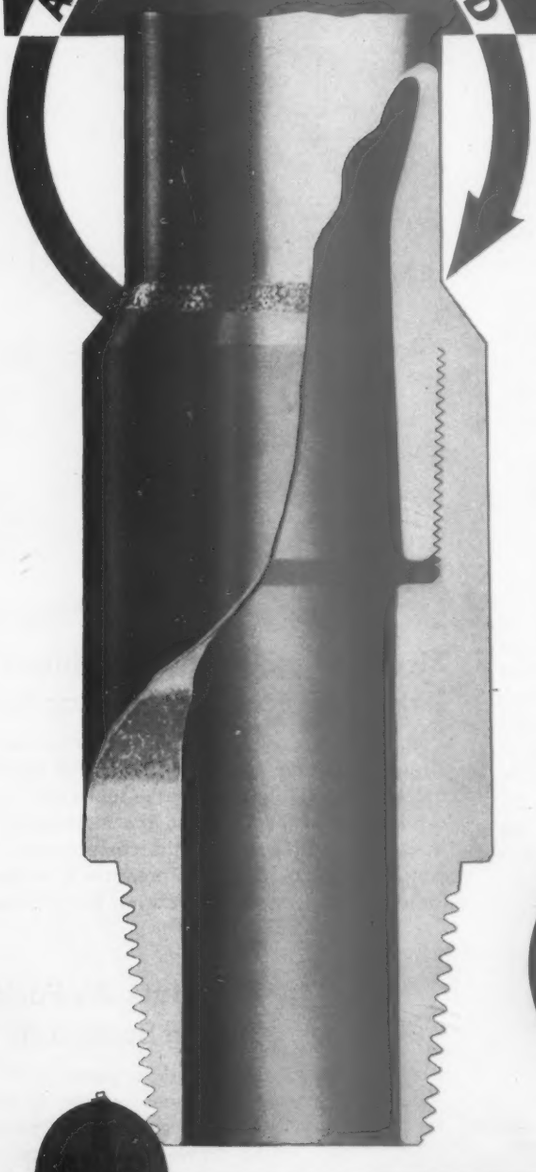

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Counterbore Weld

SHAFFER PATENT No. 2,211,173

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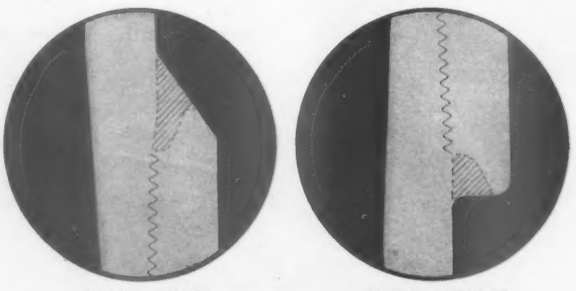
If you prefer your Tool Joints welded onto your drill pipe, the Reed Counterbore Weld Tool Joint is your answer.

The Reed three-bead process of welding produces a strong, sturdy weld, as each bead is normalized as it is applied. Deep penetration provides maximum holding capacity, and effective distribution of stresses is assured.

"There is a Reed Tool Joint design to meet your every requirement."



PIN END **BOX END**

SHADED PORTIONS SHOW AREA OF WELD

REED ROLLER BIT CO.

P. O. BOX 2119 HOUSTON, TEXAS

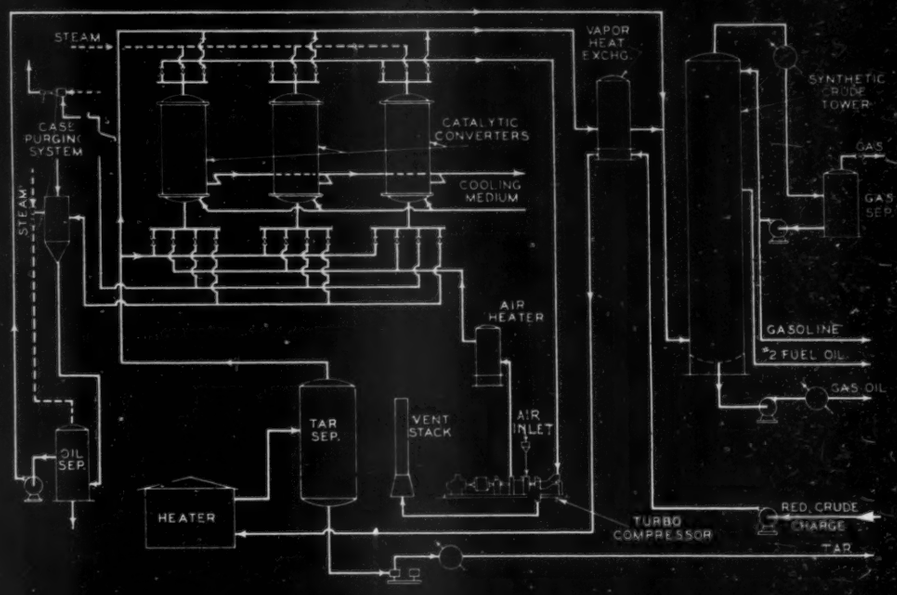
Flow Charts for The Synthesis of Aviation Gasoline

(See Pages 95, 98, 103, 106, 111)

CATALYTIC CRACKING:

Three commercial catalytic cracking methods are available. The conversion temperature employed is near 886° F. and about 45 per cent of the charge is converted in the first pass. Silica and alumina are generally used as catalysts.

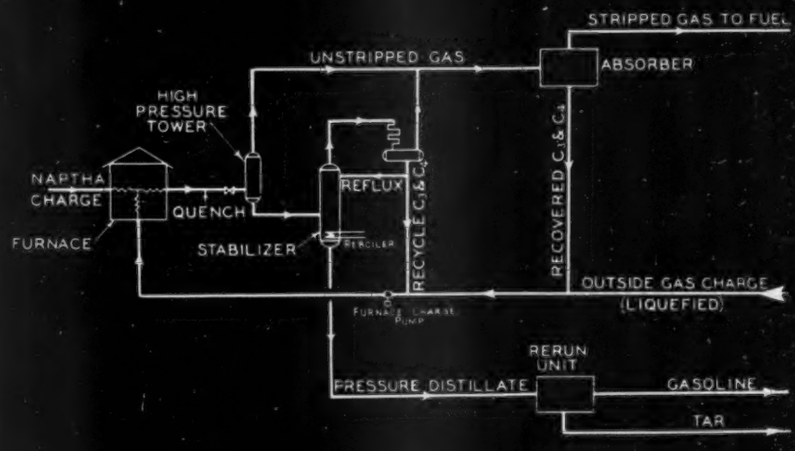
At relatively high temperatures, catalytic cracking produces more of the low-boiling-point olefins and alkylated aromatics and at relatively low temperatures, isomeric paraffins, naphthenes and complex aromatics are formed. A "Houdry" unit is shown here.



NAPHTHA—GAS REVERSION:

Where large quantities of byproduct liquefied petroleum gases are available and it is desirable to reform low-octane naphtha, the two may be processed through a reversion system. These fractions compliment each other with respect to the relationship of hydrogen and carbon atoms present, so by cracking and polymerizing a substantial quantity of hydrocarbons can be recovered which have a boiling range within that of motor gasoline.

The resulting product is usually a mixture of hydrocarbons which must be redistilled to yield gasolines of commercial range.



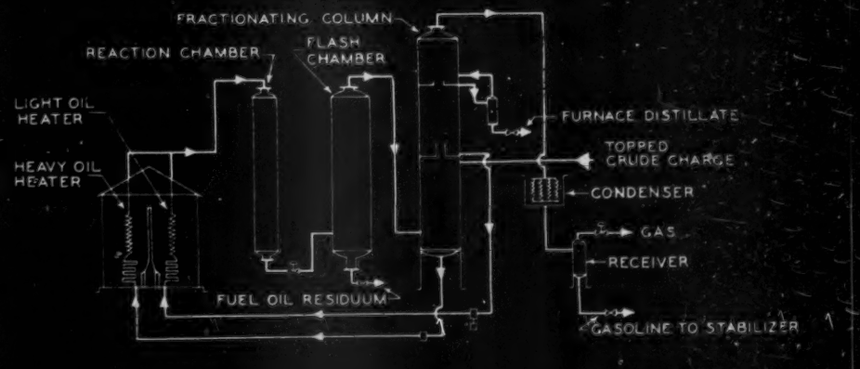
THERMAL CRACKING:

The process manufacturing the largest quantity of gasoline depends only upon heat and pressure to convert the complex heavy oil hydrocarbons into simpler ones which boil within the gasoline range. The higher the temperature used, the smaller the molecules formed.

In the flow chart shown (two-coil selective Dubbs operation), the charging stock is a topped crude and here the optimum cracking conditions are maintained in each side in order to convert most effectively the respective charge. The temperature of the oil to be converted in the heavy oil heater is brought up to 968° F. at about 275 p.s.i.

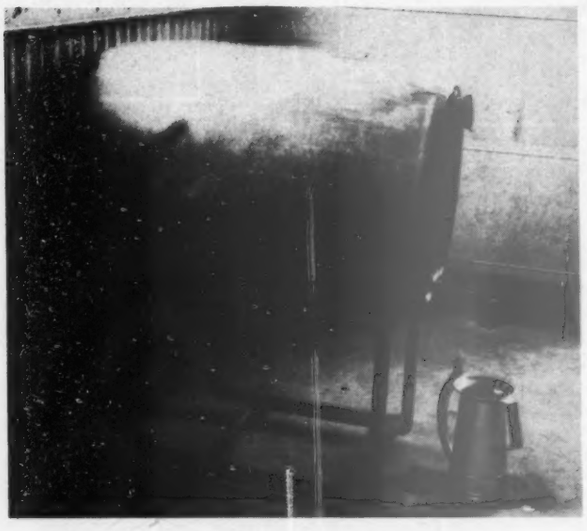
The cracking conditions in the light-oil compartment are more severe, depending upon the nature of the charge there.

In a reforming operation, the temperature of the oil is usually brought up to 1,022° F. and the pressure maintained at 750 p.s.i.



Refinery IDEAS

. . . that save $ $ $



Cradle for Lube Drum

Sometimes the operator needs to refill his oil-dispensing can several times while filling engine with a lubricant. Rather than make the trip to the oil drum where the supply is stored it may be practicable to roll the supply drum to the engine. One refiner has equipped one of his supply drums with a cradle and rollers so that the drum may be conveniently moved. The construction of the frame is distinctly shown here.

Bending Small Pipe at Plant Site

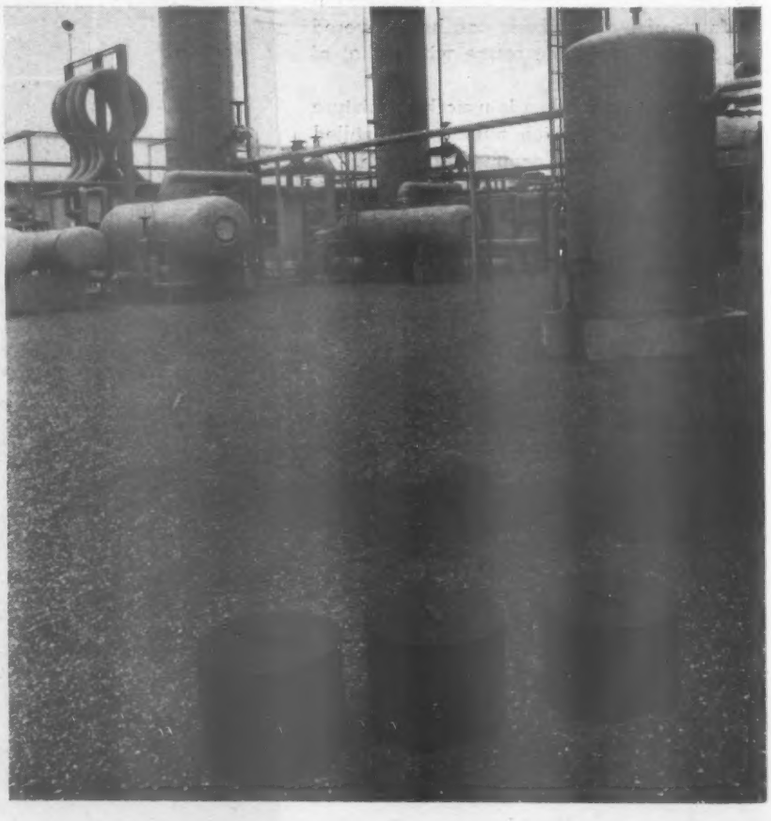
A concrete block securely imbedded and so cast as to expose a series of round holes into which dies may be inserted can serve as a means for bending pipes easily. The dies might simply be a flattened pin and a steel wheel. Here the arrangement of the slots and the nature of the dies found practical in one plant are shown. If small pipes are to be bent, this can be done by hand while the bending of large pipes might require a block and tackle. Obviously, the security of the concrete block and the size of the dies will determine the size of the pipe which may be safely handled.

Bolted Tank Serves as Appropriate Station

At a prominent road crossing in the Mid-Continent oil fields a filling-station operator has erected a 1,000-bbl. bolted tank with modifications to serve as a station. The building attracts the attention of the oil-field operators and is unusually economical both in first cost and in maintenance. Welded window frames and a door frame had to be provided but other than these and some reinforcing members for the sign on the roof, the erection of the tank was conventional. Obvious also is the opportunity for the operator to use the tank surface for painted displays.

Underground Valves Protected And Easily Accessible

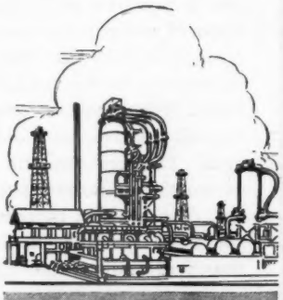
Economy of construction and greater safety is sometimes provided by inserting valves below the ground level when the lines they serve are buried. The protection of these valves against moving objects on the ground and their protection against freezing is provided for in one plant by a substantial section of large-diameter pipe around each valve and over which a tightly fitted steel plate serves as a lid. Each section is spot-welded to the line which it serves. A collar is welded to the plate just inside the periphery to hold the plate in position. This plate is also pierced in two places to permit the sides of the handle to slip through.



We are making a real all-out effort

IT is hardly necessary for us to tell our customers that it is becoming increasingly difficult to fill their orders as promptly as we should wish. The effects of the complex influences at work in the war production program are now well understood. Our products and the materials from which they are manufactured are on the critical lists, and are subject to priority control with its unavoidable delays and disappointments.

You can be assured however that our entire organization is making a supreme effort to meet the difficulties as they arise, exerting every facility to meet the needs of your industry which is so vital to the war program. We want to stress the point that your orders today are as carefully handled as they were during those days of recent memory when our big problem was not how to meet the demand but how to keep our men employed and best occupy plant facilities.



WORTHINGTON EQUIPMENT *for the* **PETROLEUM INDUSTRY**

DIESEL AND GAS ENGINES
CONVERTIBLE GAS-DIESEL ENGINES
STEAM TURBINES
SPEED CHANGE GEARS
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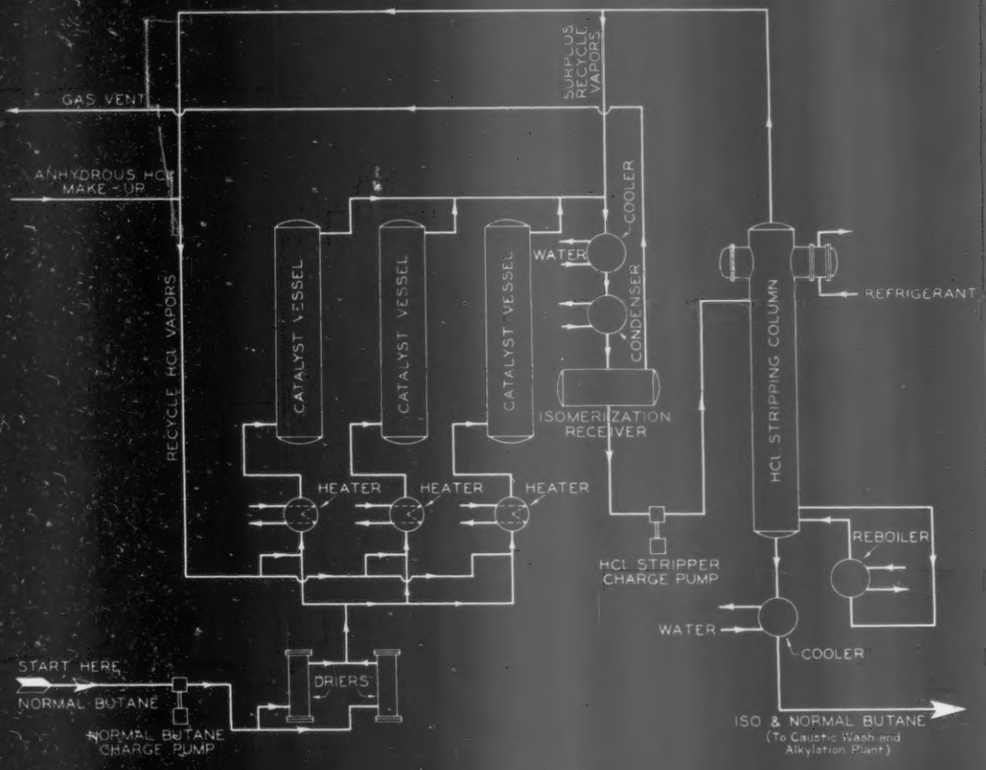
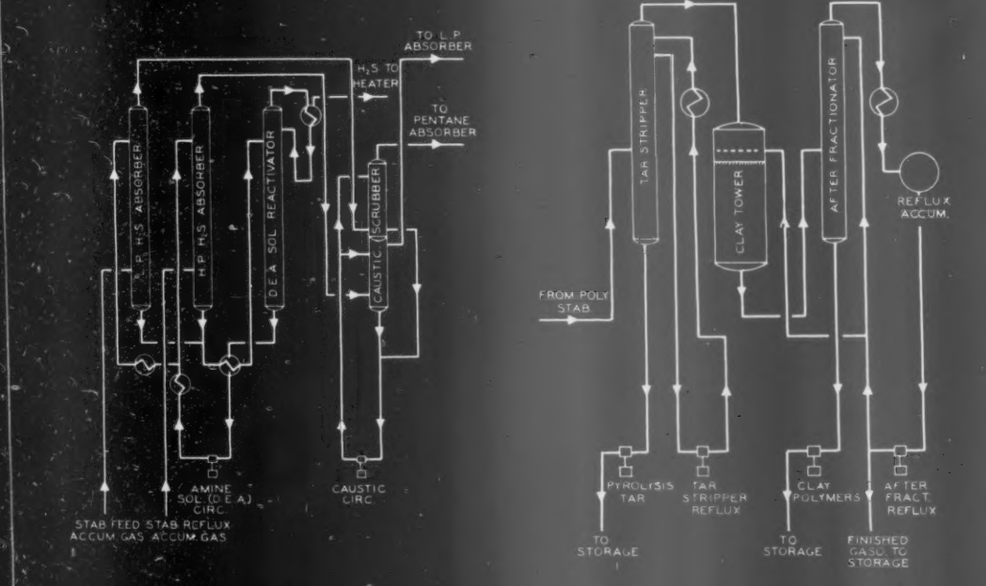
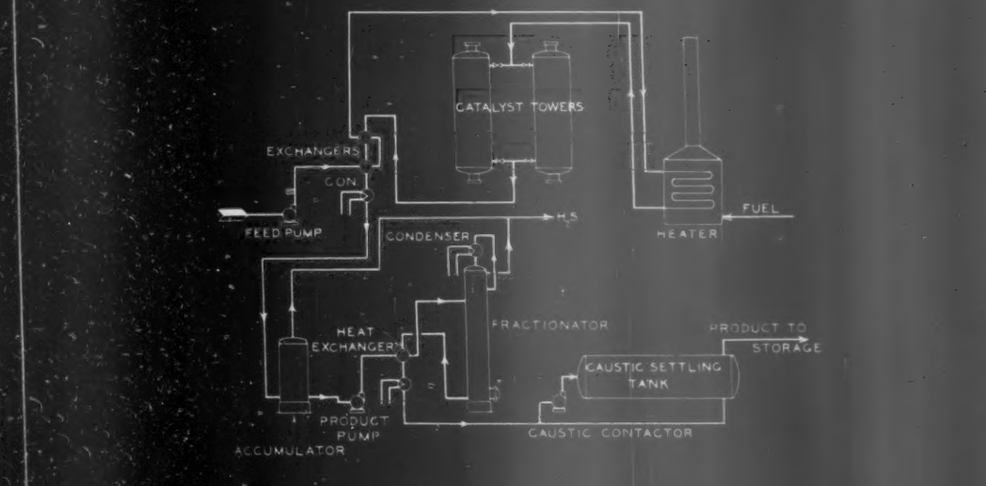
Flow Charts for The Synthesis of Aviation Gasoline

(See Pages 95, 98, 103, 106, 111)







ISOMERIZATION:

Under present operating conditions, a shortage of isobutane exists. This is a key hydrocarbon in the synthesis of 100-octane gasoline. The deficiency is being overcome, however, through the installation of isomerization plants which convert normal butane, of which there is an ample supply, into isobutane.

The conversion takes place at 347° F. under a pressure of 35 p.s.i. and in the presence of anhydrous aluminum chloride and hydrogen chloride. More than 50 per cent conversion is practicable on a once-through basis. When the unconverted butane is recycled, the over-all yield is raised to 90 per cent. The process can be applied to the conversion of normal pentane, to isopentane, etc. The process represents one of the major developments in the large-scale synthesis of high-octane pentroleum fuels.

FEED AND PRODUCT TREATING:

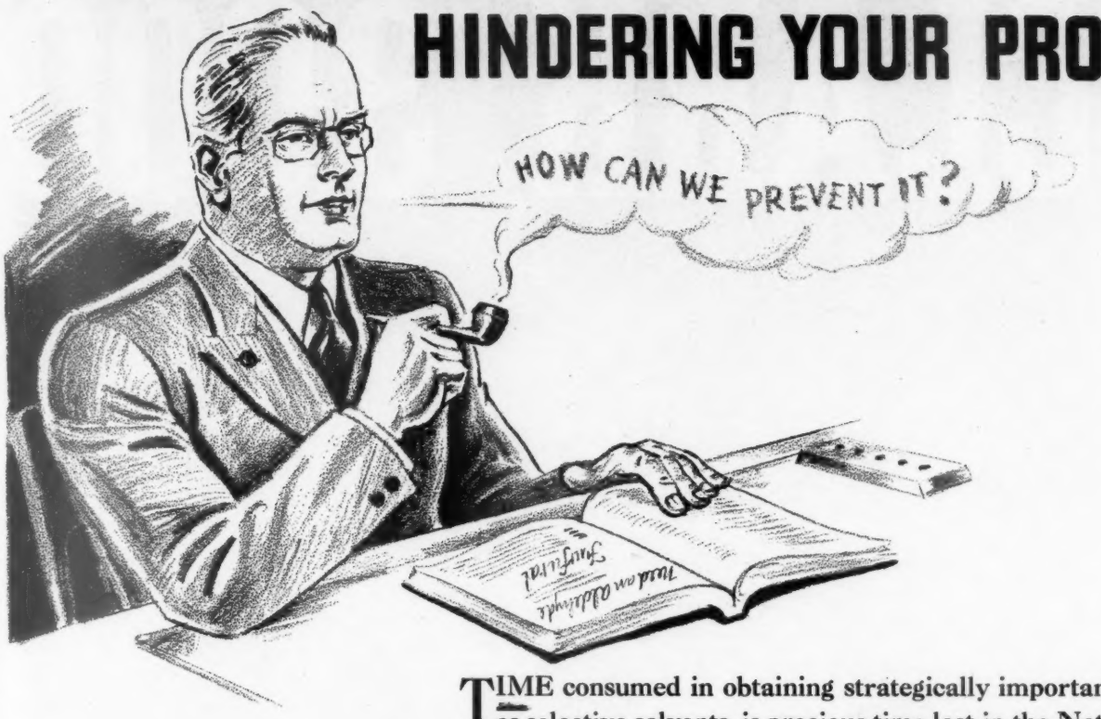
The chemical treatment of charging stocks to remove reactive impurities is doubly essential in some of the catalytic conversion processes now entering refining operations. Often the reactive impurities can influence the conversion unfavorably or they can poison the catalyst and render the operation short-lived.

Several types of desulfurizing reagents are available for application before the refinery gases are liquefied and especially before they are cracked, polymerized or isomerized. At the extreme left is a gas-treating unit in commercial work.

The products of polymerization, isomerization and cracking need chemical treatment in varying degrees in order to make them suitable for the market, and at the immediate left a typical "clean up" unit is shown as it applies to a polymerization operation.

Below is shown a popular catalytic desulfurization unit and it is applicable over a wide range of refinery charging stocks and products.

ARE SOLVENT SHORTAGES HINDERING YOUR PRODUCTION?



TIME consumed in obtaining strategically important chemicals, also used as selective solvents, is precious time lost in the Nation's war effort. Your patriotic duty is to bend every resource in easing the strain on those critical materials, so if you contemplate installation of solvent treating facilities get acquainted with an *available* selective solvent—

The Furans

FURFURAL
FURFURYL ALCOHOL
TETRAHYDROFURFURYL ALCOHOL
HYDROFURAMIDE

Furfural

Here is an economical, safe solvent used in a simple and easily operated process. Quality of the finished oil is excellent, and it is generally recognized as a premium product.

With these features you have the added advantage of knowing your use of this selective solvent does not further aggravate existing shortages. There is a plentiful supply of Furfural, made from domestic raw material in the center of the Nation.

To many individuals it comes as a surprise to learn that Furfural is heated repeatedly to temperatures of 400° F. and above without decomposition. Properly handled it is amazingly stable.

Write for a copy of the free booklet entitled, "Furfural As A Selective Solvent." Your questions are invited.

Write for this Free Booklet

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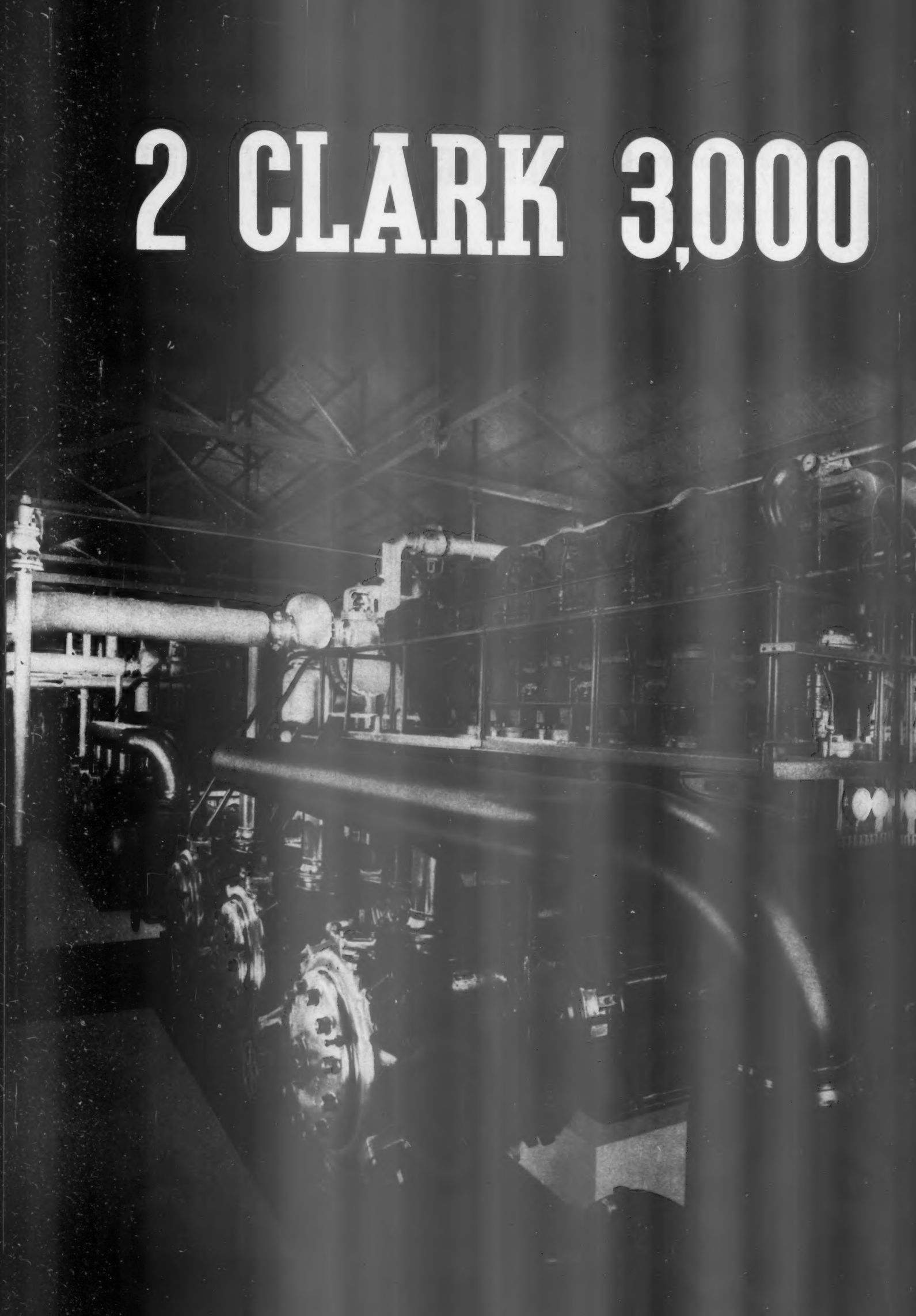
FURFURAL - FURFURYL ALCOHOL - HYDROFURAMIDE
. . . TETRAHYDROFURFURYL ALCOHOL . . .

2 CLARK 3,000



H.P. Steam "Angles"

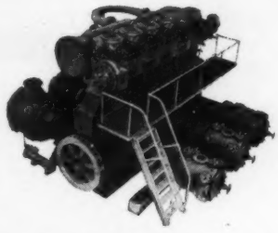
AND 3-1000 H. P. GAS-DRIVEN "ANGLES" IN THE UNION OIL COMPANY REFINERY

at Oleum, California . . . are serving in two important ways in making Hi Octane gasoline.

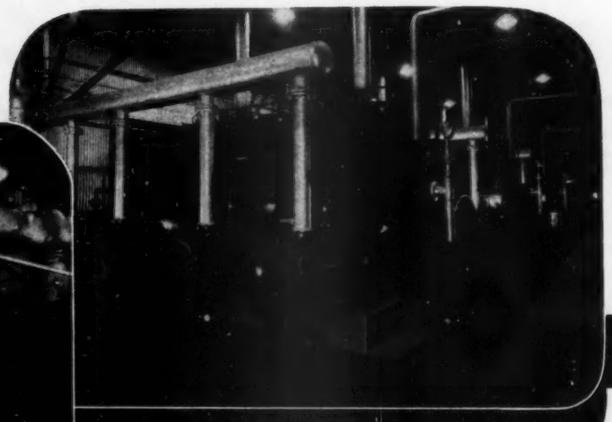
Low quality gasolines are being converted into Hi Octane gasoline by catalytic cracking. The 2 CLARK 3,000 H. P. steam-driven "Angles" furnish compressed air to burn coke, tar and asphalt from the catalyst, keeping it in efficient operation. A gas residue is then compressed by the 3 CLARK 1000 H. P. Supercharged gas-driven "Angles" to recover 8 to 15 additional gallons of highest grade gasoline per 1000 cu. ft. of residue gas.

In defense production, CLARK "Angles" are also being used for Alkylation, another new cheap method for making 100 Octane gasoline, and for producing Toluol for TNT, Artificial Rubber, Synthetic Alcohol, Synthetic Ammonia for explosives, and other important products.

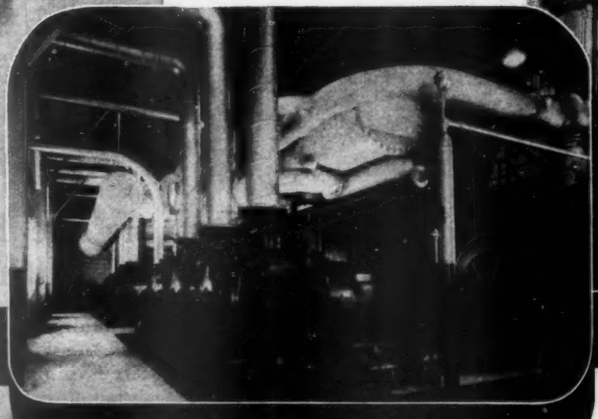
For more than 6 decades CLARK Compressors have been proving their dependability, averaging probably 98% continuous operation with few shut downs and these only after long service. Features are CLARK Super-2-Cycle Fuel Injection, no inlet or outlet valves, large bearings and few, large parts.



CLARK Steam-Driven "Angle" Compressors are offered in 3, 4, 5, 6 and 8-cylinder models ranging from 500 to 4,000 H. P. New, efficient. Ask for Bulletin 200-73.



Three CLARK 1,000 H. P. Supercharged Gas-Driven "Angles", Union Refinery



At left and above: Two views of CLARK 3,000 H. P. Steam "Angles", Union Refinery

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THE DANGER LIES AT THE TURNS

...Taking the curves FAST is equally treacherous in piping!

TUBE-TURN FITTINGS MAKE EVERY PIPE SYSTEM STRONGER AND SAFER

When pipe lines snake their way thru a plant like these chemical lines, forming neat, compact layouts, it's little wonder engineers insist on TUBE-TURN fittings. There are no flanges to tighten, no gaskets to replace—no chance of dangerous leakage. The turns indicated above —*where the danger lies*—are strong and safe—fully protected with TUBE-TURN welding fittings.

There's less flow resistance and pressure loss when you use Tube-Turn welding fittings

A flashing glide down the mountain side into a splendidly executed *Kristiana*—a sweeping turn at full speed that scarcely slows the skier! It's the same kind of uninterrupted flow that engineers desire in piping—and TUBE-TURN welding elbows and returns assure minimum resistance, thanks to the easy sweeping radius throughout. TUBE-TURN fittings' smooth inner walls are free from waves, scales or ridges which often accelerate corrosion and erosion. TUBE-TURN fittings give *plus strength* where the danger lies—at the turns—wherever there is a change *in flow direction!* For safe, trouble-free piping systems, insist on TUBE-TURN welding fittings!

Write today for TUBE-TURN engineering data book and catalog.

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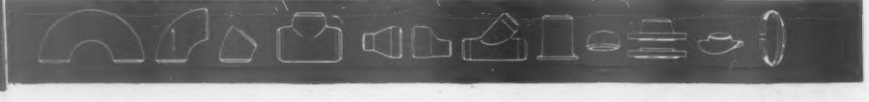
TUBE-TURN TRADE MARK — The FIRST WELDING FITTINGS 1ST AND STILL THE BEST — *Welding Fittings*



Flow Charts for The Synthesis of Aviation Gasoline

(See Pages 95, 98, 103, 106, 111)

NAPHTHA—POLYFORM:

Another form of "cracking" in which naphtha and an outside light fraction are charged as an intimate mixture to the heating zone, is known as "polyforming." The C_3 and C_4 are heated in the presence of the more complex molecules and by cracking, polymerization, alkylation and cyclization, a gasoline of intermediate distillation characteristic is formed.

HYDROFORMING:

Reforming straightrun gasoline or naphtha in the presence of a catalyst and in an atmosphere of hydrogen enables the refiner to convert low-octane fuels into gasolines of 80-octane number or higher. Despite the presence of hydrogen in the reaction zone, dehydrogenation takes place with the formation of aromatics.

The catalyst chambers are alternated in service, the exhausted one being regenerated with air. The rate of revivifications is controlled by diluting the air with flue gases.

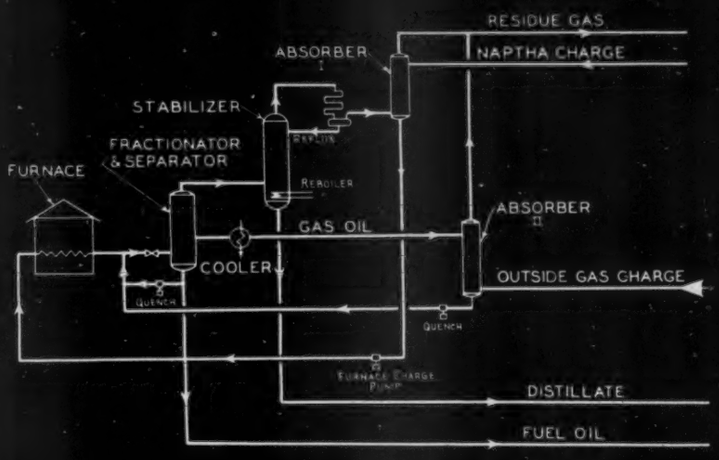
The products of this unit contain a high percentage of toluene (15 to 20 per cent). The volume of aromatics in the gasoline fraction accounts for about half the total.

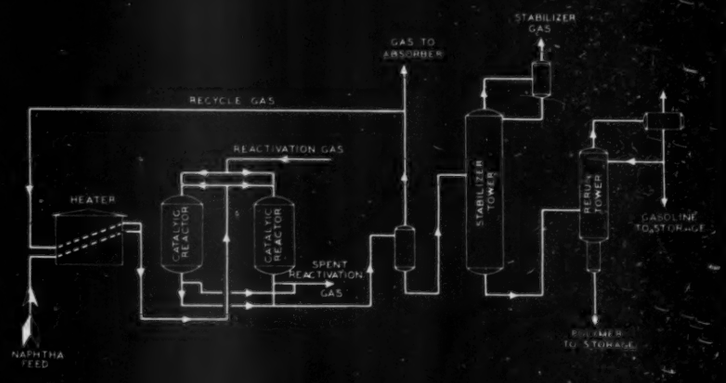
NAPHTHA—POLYFORM:

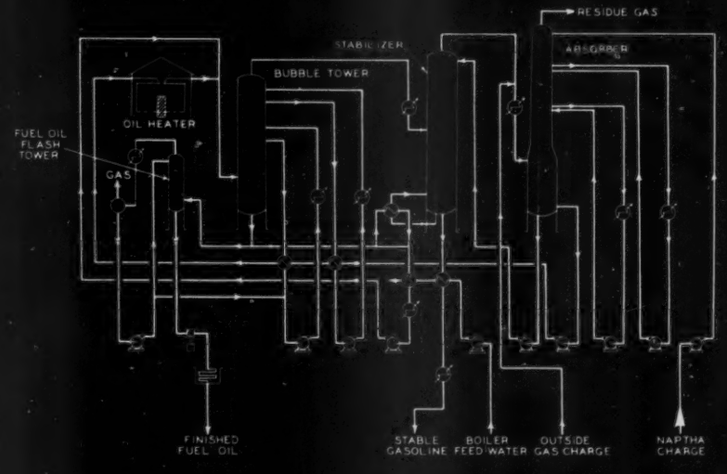
The opposite flow chart appearing here is very similar to that at the top of the page and the discussion of the latter applies here also. The lower chart suggests a more detailed flow arrangement and gain in thermal efficiency, but the type of charge, method of processing and nature of the products are alike generally.

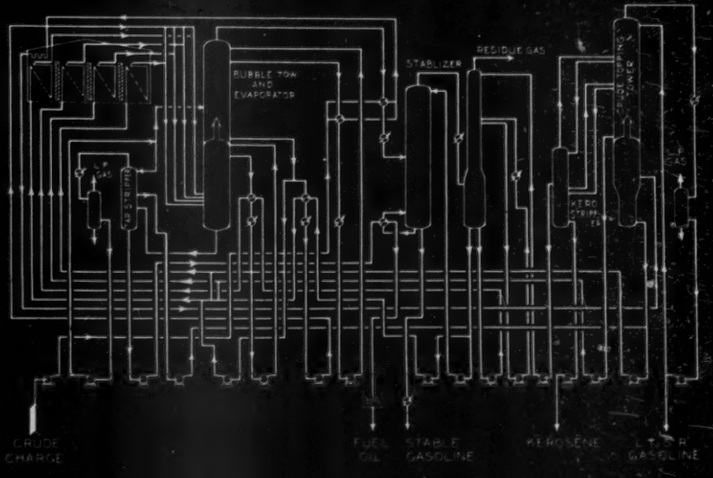
FOUR-COIL CRUDE-POLYFORM:

A further advance in the conversion of straightrun naphthas into high-octane gasolines within the crude-topping unit is shown here. The four heating elements provide for cracking gas oil, naphtha, gas and a portion of the fuel residuum.









Gasoline Additives

(Continued from Page 84)

available fuel he intends his engine owners to use. Furthermore, the curve does express and illustrate a problem which the refiners of petroleum products can and want to do something about.

Obviously, the refiners and marketers of motor fuels cannot do anything about the original design of engines once they are on the market, but they can do something about the deposition caused by the burning of the fuels and lubricants in engines. Again referring to Fig. 11, if the sum-total effect of engine deposits is of the order indicated by increased antiknock-fuel requirement, and, by referring to the earlier figures, it is apparent that this value is equivalent to 10 to 12 per cent of the total power output of the engines. Therefore, if the petroleum industry can do something about the deposit occurring in engines, obviously the power output of the engine would be directly proportional to the efficiency with which part, or all, of the effective (from the point of view of being deleterious) deposition is handled.

A rather detailed study of the rise of the octaine requirement of an engine with hours of operation is illustrated in Fig. 12. The curve shown in this figure illustrates the rise of the apparent octane requirement of the engine together with the weight of the carbon deposit on the piston head, together with the curve illustrating the reduction of volume of the entire combustion chamber, with time. In studying carbon deposition* in multicylinder engines, combustion-chamber volumes have been periodically measured, then the cylinder head taken off, the piston crowns photographed, weighed, and the engines rebuilt and run for another period of time, after which the process is repeated. On small engines (Lausons) this process is performed every hour, and some of the runs were several hundred hours long. On the larger engines the work was performed every 500,000 revolutions. From these data, data for the type of curve shown in Fig. 12 were obtained.

*Carbon deposition is used loosely to mean the sum total deposit which, of course, includes lead, lead compounds, foreign material such as road dirt, sand, etc., as well as carbonaceous material.

It is obvious that the apparent octane requirement of the engine gradually increases with time, or miles, of operation until an apparent equilibrium is reached. The curve in its general shape, in so far as apparent octane requirement of the engine is concerned, is a typical curve and is verified by Mr. Macauley's curve shown in Fig. 11.

Fig. 13 illustrates the scheme used for the construction of the pistons for this work enabling us to remove the piston crown without disturbing the ring condition, or any of the engine conditions except the removal of the head from the engine. All of this work has been necessary in order to study carefully the manner in which combustion-chamber deposit is formed, the rate at which it is formed, and the manner in which it maintains itself at any definite equilibrium for any set operating conditions, as well as the manner in which it attempts to, and does, accomplish its changes from one equilibrium condition to another with a change of operating conditions.

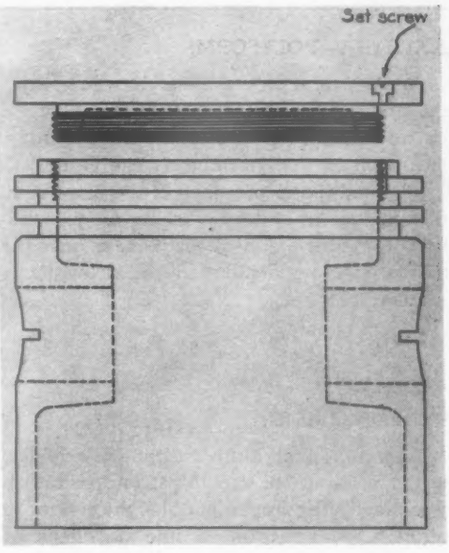


Fig. 13—Sketch showing how the removable heads are made for single-cylinder small test engines and multi-cylinder full-sized test engine

So that the results of these studies may be easily understood, Fig. 14 shows, diagrammatically, a top and a profile view of a piston crown. Initially the deposit seems to form in what may be described as droplets, or globules, which are rounded at the top, and appear to be more or less evenly spaced. For any given condition, these little deposit globules assume a rather definite height. If deposition continues, the space between these becomes filled up until, theoretically, we have a somewhat even layer of a rather definite height or thickness over the entire crown. The height of this layer would seem to depend primarily on the rate of heat conductivity from the combustion chamber through the piston crown, and is hence somewhat proportional to piston-crown cooling. The hotter the combustion chamber the less the thickness, while the cooler the combustion chamber, within limits, the greater the thickness of the deposition layer. It should be noted that the discussion of piston-crown deposition is applicable to the balance of the combustion-chamber deposit.

In other words, the rate of thermal conductivity from the top of the layer to the bottom of the

WHEREVER THE OIL INDUSTRY
FACES A PROBLEM OF
HEAT

WHATEVER the type or grade of lubricant or fuel desired, the heart of the refining process lies in the heater. Here lies the answer to dependable, economical operation. For eighteen years Alcorn has been asked to solve all types of heating problems. And for eighteen years Alcorn has been able to answer such problems adequately.

ALCORN COMBUSTION COMPANY
SCHAFF BLDG., PHILADELPHIA
LOS ANGELES HOUSTON SAN FRANCISCO

layer, which is adhered to the piston crown itself, must be such that the temperature at the top of the layer is below its incandescent temperature. If the rate of thermal conductivity through the layer is great enough so that the top of the layer is maintained below its incandescent point the layer remains, and even attempts to build itself higher. When, however, the thickness becomes great enough so that it can no longer

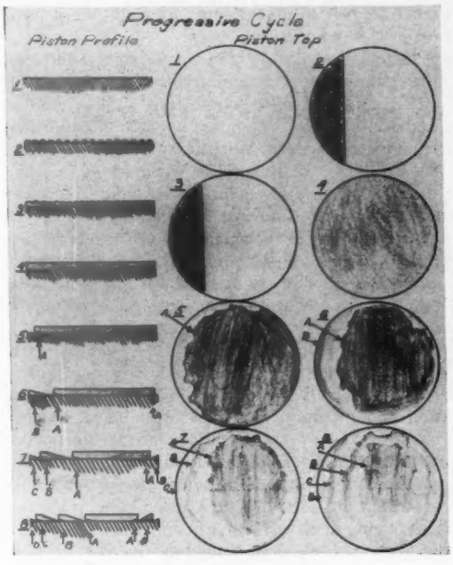


Fig. 14—Sketch showing buildup and carbon cycling as occurring on average piston head. This type of cycling generally occurs elsewhere in combustion chamber, notably on the engine head. However, instead of cycling inward towards a center as illustrated here, the cycling is generally from a point outwards

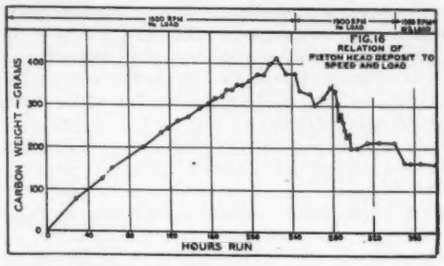
transfer the heat fast enough through itself, the top of the layer will then become incandescent and begin to burn off. When this occurs, it does not just burn off down to the equilibrium layer, but burns off faster and deeper and may even burn down to the metal itself. Then, having burned off below the point where heat transfer is sufficient to maintain an equilibrium, as shown in the next picture, another layer begins to build up on the piston crown before it, in turn, offers sufficient heat resistance so that this new layer becomes incandescent and again goes through the same cycle.

We have called the theory by which the building up and the burning off of the deposition in a combustion chamber is explained, the carbon-cycle theory,* or deposition-cycle theory. The building up, and the burning off, of the deposit is not done evenly all over the piston nor all over the head of the combustion chamber. The cycling points and locations are dependent upon the rate of cooling of the various portions of the combustion chamber and the differences in the rate of cooling between adjacent portions. In other words, cycling will be observed to take place all over these portions without any apparent rhyme or reason, until the cooling of those parts is also considered. It should be noted that cycling generally occurs in a wave-like front either convex or concave in shape.

Fig. 15 is a photograph of a piston head and is typical of that which we have all seen time and time again. Perhaps, however, we have never analyzed why the deposition appears on the piston crown as it does until it has been carefully explained by the carbon-cycle theory.

Thus far only one condition of equilibrium has been discussed and that has been under a constant-speed and constant-load set of operating conditions.

However, Fig. 16 illustrates the fact that for



*This phenomena was first noted by J. F. O'Laughlin, of Pure Oil Co.

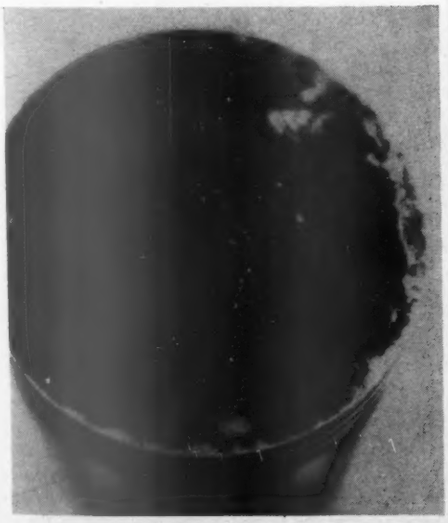


Fig. 15—Typical piston as is found in the average used passenger-car engine

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each speed and for each set of loading conditions at that speed, the engine attempts to maintain a very definite set of deposit-equilibrium conditions. In other words, not only must the work and the energy be used in a combustion chamber to maintain one set of equilibrium conditions, but, in a case of an engine which has varying speeds and loads, the engine is constantly striving to maintain a deposition equilibrium for each and every speed and load condition. This naturally results in a considerable disturbance in the combustion chamber which, of necessity, robs the engine of power as the deposit-thermal equilibrium attempts to change for each succeeding set of engine-operating conditions.

For example, a car being driven in the city stops at stop lights, and is idling, consequently, has no load. Deposit material is being quite rapidly deposited in the combustion-chamber space. The operator then steps on the accelerator and applies full load to his engine as he speeds up, and another set of equilibrium conditions is attempting to be obtained and maintained. Then as he goes along at city driving speed, still a third set of equilibrium conditions is striving to be maintained. Again he stops at a light, and the situation, in so far as the deposition is concerned, may start all over again. In other words, just like a pendulum going back and forth, the engine is striving to maintain equilibrium conditions which, in all probability, are probably never fully established. Therefore, the condition which is generally found in that engine is the average of that which the engine can do for the manner in which the engine is being driven. We have seen earlier that carbon deposition robbed the engine of approximately 11 to 12 per cent of its power output. The reason is that actual work must be done to maintain any deposition equilibrium and even more work may be done in the striving of the engine constantly to change equilibrium conditions from one load and speed-operating condition to another.

Thus far the picture of the condition which is maintained in an internal-combustion engine by the engine itself has been discussed—at the cost of engine-power output. Obviously, it is quite simple to see that if something can be put in the gasoline which will, of and by itself, maintain a deposition equilibrium below that equilibrium which the engine would otherwise maintain, the engine will not lose the power that would otherwise be lost in its attempt to maintain its own deposition equilibrium.

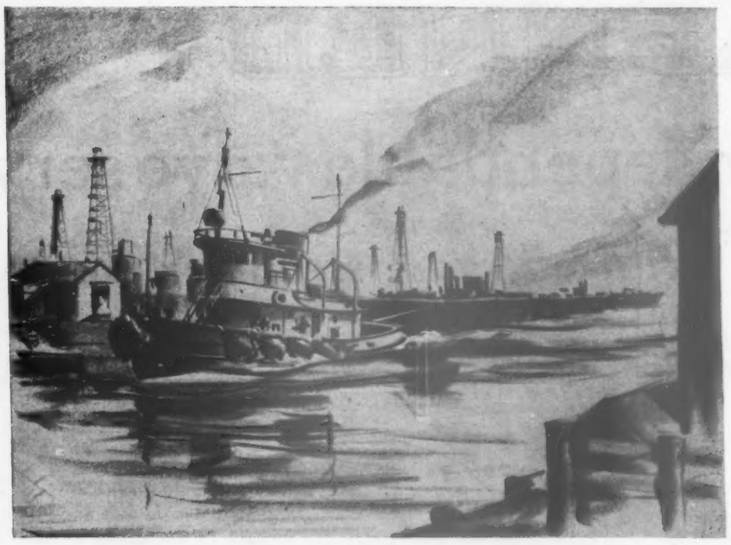
In other words, if, by means of some additive in the fuel, the work of maintaining the lowest deposition equilibrium to which that engine, running under its own particular operating conditions, would ever itself attain, the engine has not only been relieved of doing the work of maintaining the deposition equilibrium itself, but it has also been relieved of having its entire thermal cycle disturbed by the unbalancing of the forces required to maintain varying and various deposition equilibriums. The result is, if we have succeeded in doing this completely, a restoration of power available at the wheels of 11 to 12 per cent in the average engine. On the other hand, if that part of the deposit above the lowest equilibrium point to which the engine itself would ever attain and maintain can be accomplished, there is no need to worry particularly about the portion of the deposition below that basic, or lowest, equilibrium point. The above reasoning, with the exception of some further discussion regarding rings, ring grooves, valves, and valve stems, is basically the reasoning behind the use of additives in fuels.

For sake of ease of discussion, that equilibrium deposit below that which the engine itself will ever attain has been termed the basic deposit; and that portion of the deposit which is constantly building up and burning off and which affects engine performance has been called the excess deposit.

However, before the work on deposit can be discussed, it might be well to point out that deposits in combustion chambers vary considerably. In our work we have classified them in, more or less, four general classifications. Each of these classifications has various subdivisions which may be crudely defined by the type of deposit edges found on the pistons. Obviously the edges do not occur on the head of the block or on other parts of the combustion chamber, except perhaps in rare cases on intake valves. However, for simplicity, the types of deposit on the piston heads themselves will be illustrated.

The first type of deposit is illustrated in Fig. 17 and shows the blackish type of deposit which

Fig. 17—Thick, blackish type of deposit generally found in lower compression heads. Edges show that oil has come up from the crankcase and has aided in the removal of a portion of deposit. Note also five cycling waves on upper side of the piston head



"OIL BARGES" from a lithograph by E. M. Schiwetz

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is soft and which is generally found in engines having low-compression heads. It is fairly easy to handle; it is not waxy, but it is somewhat porous. Almost any type of fuel additive will affect, to a greater or lesser degree, this type of deposit.

The second type of deposit, as illustrated in Fig. 18, is still of the blackish type, but is somewhat harder and more compact. The illustration shows the edges are also black as were the edges in Fig. 17, but that they are not softened to nearly as great a degree by the motor oil coming up by the rings as those in Fig. 17. The deposit is, by this measure alone, a little harder to handle than the first type.

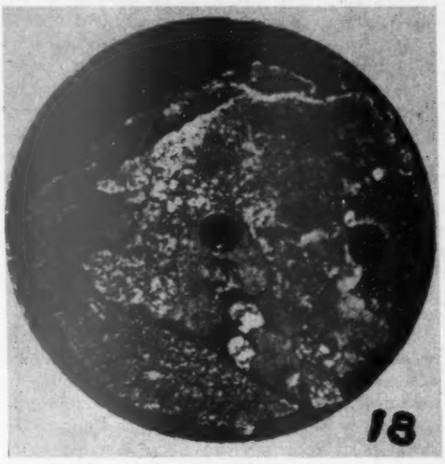


Fig. 18—Second type of deposit generally blackish, but somewhat harder and more compact. Cycling is not so easily seen, but here too motor oil has come up the side of the piston and has softened deposit

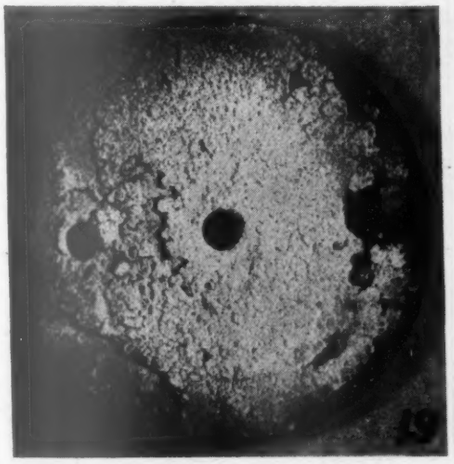


Fig. 19—Third type of deposit. Harder and more closely knit than first two

Fig. 20—Extremely hard, smooth type of deposit which is rather difficult to handle. It is close-grained and high specific gravity

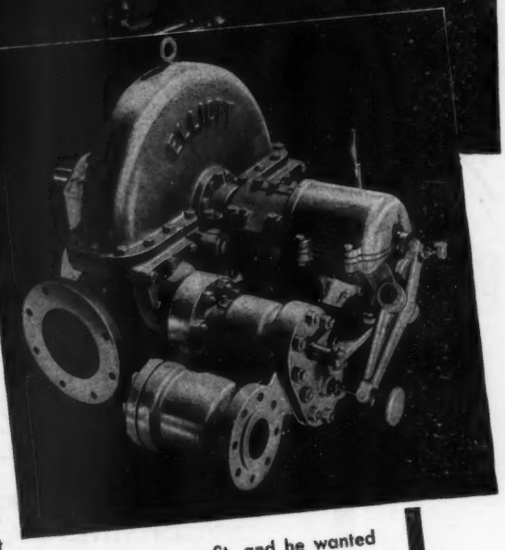
Later Types of Deposit

The third type of deposit is illustrated in Fig. 19 and was not often encountered in the average automotive type of engine until about the 1939 type came along. Note that it is grayish, or whitish, and is somewhat rough. It is a rather difficult deposit to handle. The darkened edges are due to the motor oil coming up around the rings. This type of deposit is generally found in engines having a higher compression ratio than the first two types and the metallic content begins to predominate, assuming higher percentages in the deposit, especially on cross-sectional analysis as we go across the head towards the exhaust valve.

The fourth type of deposit as illustrated in Fig. 20 is an extremely hard, smooth, compact type of deposit. This is generally an extremely difficult type to handle by means of gasoline additives. It is close-grained, and has a rather high specific gravity and metallic content. This type of deposit generally predominates in the higher-compression type of engine.

Obviously, the deposits in the balance of the combustion chamber, while different, depending on the part of the combustion chamber where they are found, seem to be patterned after the type of deposit found on the piston head. Further, the same analogy attains with reference to the deposits in and around ring grooves, valves and valve stems, although these deposits may be affected to a greater or lesser extent by the motor oil and its compatability with the products of combustion of the fuel, both the partially and the

An Elliott 197-hp. turbine driving three pumps in tandem, in a natural gasoline plant. There are several similar tandem drives in this plant.



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completely oxidized residue. Further, it is quite obvious that the quantity of the deposit has varied somewhat with the compression ratio of the engine.

Deposit on Cylinder

Generally it would appear that as the compression ratio of the engine increases, the quantity of the deposit on the piston head has decreased, but the type of deposit has been increasingly difficult to handle. Further, as the compression ratio has increased and the type of deposit has decreased, the effect of the lesser deposit which has remained, in some instances, has been even more pronounced especially on the moving parts such as rings, valves, etc. It must not be forgotten that the deposits on the rings and ring grooves, valves and valve stems become increasingly critical as speed is increased. For example, in the older, slower engines, a slight slowing up of the valve or ring action was not nearly so important as it is in the higher-speed and higher-compression engines of today. A modern engine operating in a car at 60 miles per hour has a valve which may function approximately 20 times a second. It is obvious, therefore, that it does not take much slowing down of valve or ring action to change materially the compression and air-fuel ratios in that engine, resulting in substantial differences in engine output. Cylinders, when the engine is hot, are generally not truly cylindrical in that the heat often tapers them or causes out of round. Many cylinders are out of round almost from the start. The tapering and the out of round of the cylinder would obviously require a high degree of ring action which, it should be noted, in itself aids in deposits packing in and around the rings. Therefore, the effect of the deposits on the rings and ring grooves, valves and valve stems, may assume quite large proportions.

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Now that the conditions under which we have to work have been briefly outlined, the problem then is, first, to maintain the basic equilibrium in the combustion chamber by means of an additive, which is to say, that an equilibrium of a lower value than that which the engine, under normal operating conditions, would itself maintain; and, second, to maintain clean valves and valve guides, rings and ring grooves. There are several avenues open to the accomplishment of these results, and the resulting method may be one of these, or a combination of them. For example, if two surfaces are to be glued together, they are obviously more readily glued if the surfaces are warm and dry. If the surfaces were wet the adhesive tendency of the glue would be greatly reduced. Another method would be to render the glue or gummy binder inert as it is formed in the combustion chamber, thereby reducing its tendency to hold the solid particles, or carbonaceous materials, lead salts, etc., together or to the metallic portions with which the products of combustion come in contact.

In the average passenger-car engine, it might be well to point out that it takes somewhere around 7,500,000 explosions in a combustion chamber under a given set of operating conditions, using a straight nonadditive type of gasoline, to produce and deposit approximately 4 g. of deposit in the combustion chamber and on the adjacent parts from a clean-engine starting condition. While a gram is rather small, it still takes something less than 2,000,000 explosions to produce 1 g. of deposit. It is readily understood, therefore, that an extremely small amount of material is actually produced and deposited after each explosion in the combustion chamber. Since extremely small amounts of deposit are being handled, it is possible to use extremely small quantities of additives in gasolines, providing the additive is effective. To illustrate this it is well known that 1 cc. of tetraethyl lead per gallon of gasoline may increase the octane number of that fuel by, for example, three or more numbers. In other words, a very small amount of a proper additive may have a tremendous effect in the over-all performance of the fuel.

In Fig. 21 the octane requirement of an engine

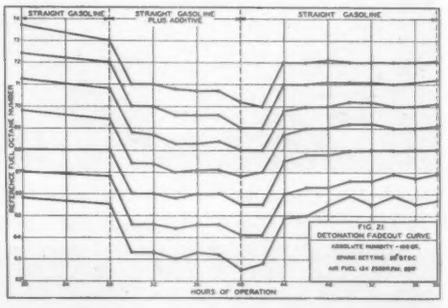

Fig. 21—Illustrates the ability to control at will, within limits, by means of the introduction of the proper additive in a straight motor fuel, the octane requirement of the engine

run on straight fuel without any additive until an equilibrium is reached is shown. A very small amount of a rather effective additive was placed in the fuel and, with no other change in operation, the octane requirement of the engine dropped to approximately that which it had when the engine was new. When the additive was no longer added, the octane requirement of the engine, in a short space of time, returned to that point, or equilibrium, which it had been maintaining prior to the use of the additive. In other words, at will, and with an infinitesimal amount of the proper additive, the apparent octane requirement of that engine was brought back to almost the new engine condition. It is obvious that not only is this additive capable of reducing

the total quantity of the deposit in the combustion chamber, but it also affects the characteristics of the deposit in the valves and valve guides, the rings and ring grooves, so that they are functioning more nearly in the manner in which they were designed to function.*

Use of Additives

Heretofore the gasoline additives only have been discussed. However, with a proper tuneup treatment a temporary purge of a large portion of the deleterious deposits in the engine may also be attained. In this type of treatment the additive is sprayed into the engine in relatively large quantities, or may be placed in high percentages in the fuel. However, generally speaking, adding it to the fuel is not so effective as is the actual spraying of this material into combustion chambers of the engine itself through the carburetor while the engine is idling, and later through the spark-plug holes after the engine has been stopped. This permits the material to soak into the deposit which materially aids in removing it.

Fig. 22 shows the possibility of this type of

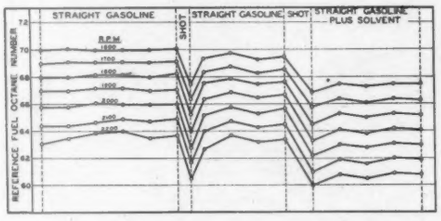

Fig. 22—Effect of two successful shots of solvent and the fact that using straight gasoline after each shot the octane requirement builds pickup rather rapidly

treatment in the reduction of apparent engine-octane requirement on a Type 3 deposit, and Fig. 23 illustrates the same effect but with another

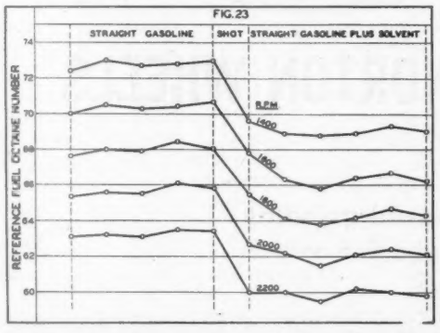

Fig. 23—Showing a shot treatment and then the use of a proper gasoline additive directly after the shot thus maintaining the apparent octane requirement of the engine at a value somewhere near that of new-car condition

type of material on a Type 4 deposit. Obviously, by means of the tuneup treatment, the octane requirement of the engine may be almost immediately reduced. Further, this reduced requirement may be maintained by use of the proper type of additives in the fuel.

It should be pointed out that the amount of additive used in commercial fuels is that amount which is found to successfully take care of the average, or normal, driving condition. For heavy-duty work, or for continued use under extraordinary conditions, larger proportions of the additive should be used for the same degree of success.

It should be remembered that there are product-exchange points, such as the ring-belt area and the valve-stem guides, between the fuel and the lubricating oil. A study of compatibility between fuels and lubricants, and between fuel additives and lubricant additives is a most interesting and important one. However, by use of a properly balanced fuel additive alone, much can be done to relieve the congestion of petroleum products and their residues at these points. The curves of the change of engine performance with and without the additive are over-all performance curves, and, as such, reflect the work which has been done at all points in the engine.

Kinds of Additives

It would appear, therefore, from the work which has been done to date that it is possible for the petroleum industry to place in their fuels additives of a nature which will, at least, take care of excess carbon deposition together with perhaps a portion of the basic carbon deposition, thereby making available for power output that portion of the energy which otherwise must be internally consumed by the engine to obtain and maintain deposition equilibrium for various engine operating conditions.

While perhaps quite obvious, it might be well to point out that additives should be composed of effective chemicals and of such materials so that when they do burn they burn clean. This means that they themselves do not leave a residue. In addition, they must have the property of carrying oxidized and partially oxidized material to where these products can be burned, and then act, perhaps, as a burning catalyst so that these products are then completely burned.

In conclusion, it would be quite safe to predict that to obtain the maximum performance from fuels as well as lubricants, the day of petroleum additive compounds, or the alloying of petroleum products, is just as inevitable for maximum and maintained engine performance as is the present alloying of metals.

*See "Specific Fuel-Consumption Curves."

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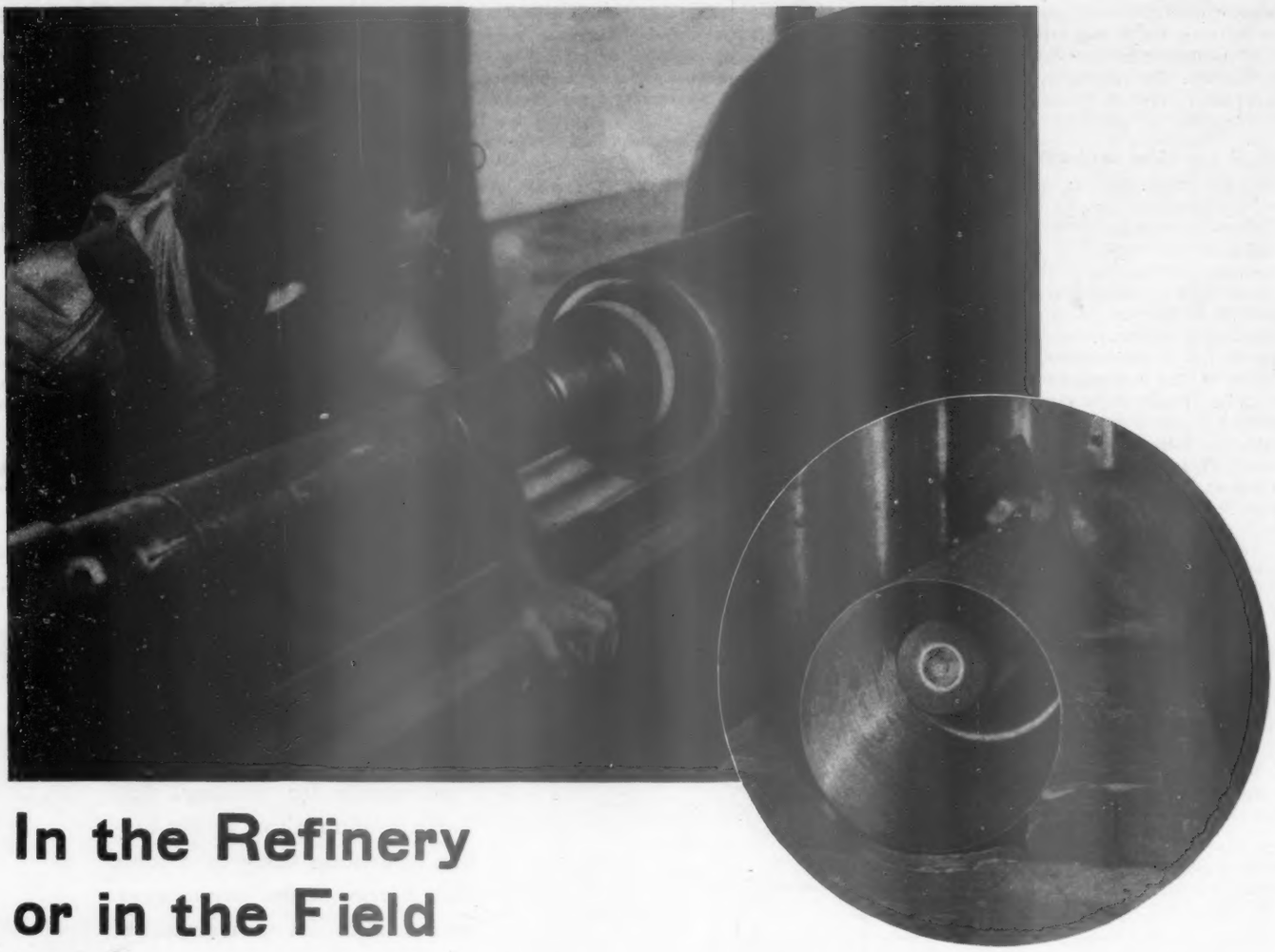

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New Ideas in Motor Control

(Continued from Page 87)

of three conduits from above, three conduits from below, and one larger conduit from each side, standard plugs being furnished for the openings least frequently used.

The idea of providing for conduit entry from below has been extended to the construction of oil-immersed pushbuttons, which are now available with the top casting overhung on a vertical conduit hub which serves as the mounting member, and is tapped for top and bottom conduit entry or the insertion of a plug if only one conduit is used.

Fig. 4—Explosionproof circuit breakers and starters, and oil-immersed combination starters installed in hazardous area of catalytic cracking unit

Experience shows that oil-immersed motor starters are subject to more rapid deterioration of contactor tips than is realized with the same contactors operating under identical load conditions in air. This is attributed in part to the slower extinguishment of the arc when the circuit is interrupted under oil, as compared with the very rapid deionizing action attained by modern air-type contactor arc extinguishers. It is also likely that in the oil-immersed contactor greater localized heating occurs during normal operation at the points where the contactor tips are in contact, due to resistance introduced by the oil film or its breakdown products. Recognizing the greater severity of oil-immersed service from the standpoint of contact surface deterioration, manufacturers have in some cases increased the amount of material in contactor tips for service under oil, the more massive contacts providing a greater reserve of material against the deteriorating action, and probably a more effective removal of heat from the active surfaces.

Constantly increasing consideration is being given to the requirements of power interrupting capacity in the application of motor starters. Each refinery and each location within the refinery presents its own individual circuit conditions, and these must be taken into account at the time the control installation is made and when subsequent changes are considered in the power system layout.

Small Circuit Breakers

In this connection, it is worthwhile to note that circuit breakers rated 600 volts and below are regularly available in all of the enclosure forms discussed above—general-purpose, weather-resisting, explosion-resisting, and oil-immersed, in designs proved in short-circuit tests on 10,000 amp. a.c. circuits. Similar tests have been conducted on combination oil-immersed across-the-line starters for service with a.c. motors 550 volts and below.

For some time there have been 2,300-volt oil-immersed starters available in ratings up to 1,250 hp. with 50,000 kva. interrupting capacity. For the many locations where the interrupting requirements are less severe, there are now available and in course of development, 2,300-volt across-the-line type oil-immersed starters with 25,000 kva. interrupting rating, which, where applicable, can be installed at a saving in cost, space, and with greater ease of handling for maintenance work.

One of the most striking trends in refinery control practice is toward outdoor location of motor starting equipment. Aside from the obvious reduction in building construction, this practice provides greater flexibility in the electrical layout and offers less opportunity for the pocketing of hazardous gases. This practice is made possible by the development of enclosures suitable for outdoor service, not merely in the so-called weather-resisting class, but also in the explosion-proof and oil-immersed forms.

Fig. 5 Oil-immersed combination 440-volt starters with overhung mounting permit direct entry of conduit from floor, minimizing cost of conduit fittings and installation. In this installation starters are connected behind oil-immersed group breakers and short horizontal conduits carry power circuits from group breaker through starter heads

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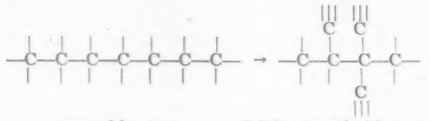
Thermodynamics in Isomerization

By PAUL BUTHOD[1] and W. L. NELSON[2]

FOR many years petroleum has, to a large extent, been processed by physical rather than chemical means. Only in the case of cracking or thermal decomposition has the bulk of petroleum been altered by a chemical reaction. Since 1912, when commercial cracking was first introduced, this phase of the industry has progressed rapidly until at the present time the capacity of cracking plants (and related processes) is equal to more than half of the crude-oil capacity, and almost half of all of our gasoline is produced by cracking. In this sense, it might be said that the petroleum industry is already a chemical one, but technologists now foresee an even greater use of petroleum as a charge stock for chemical processes. Perhaps as much as 90 per cent of the gasoline of the future will be produced by chemical processes; the lubricating oil of the future may by chemical alteration exhibit properties far superior to those of oils of today; and a multitude of small-quantity products will be manufactured as byproducts of the above operations, or by special plants if such a cost is justified. Somewhat this situation exists with regard to butadiene for synthetic rubber. Butadiene can probably be made as a byproduct in aviation-gasoline manufacture, but if this source is inadequate, special plants can be built for the express purpose of producing butadiene. The operation will be relatively small, probably not consuming more than 1 per cent of our total oil production unless a much larger consumption of rubber is caused by the low cost of synthetic rubber.

Isomerization.—Among the processes that at the moment are attracting attention, isomerization and particularly the Isomate process of the Standard Oil Co. of Indiana is commanding interest. Isomerization has been practiced commercially for some time on butane for the production of isobutane but not until the Isomate process was announced was isomerization practiced on mixtures of hydrocarbons. This process utilizes those hydrocarbons from petroleum that boil between about 50°-160° F. Although 10 or more hydrocarbons are included in this boiling range, such a fraction can be described as a mixture of pentanes and hexanes (see Table 2.). The amount of such a fraction (50°-160° F.) that is present in crude oil is rather small, being only 3 to 5 per cent, and hence the question of the suitability of other charge stocks such as those boiling to 200° F. or even 300° F. becomes important. The approximate amount of various naphthas in crude oils as well as in gasolines is indicated in Table 1.

An examination of the octane numbers given in Table 1 indicates in a general way that straightrun naphthas in crude oil consist largely of normal paraffin hydrocarbons although some "iso" hydrocarbons and naphthene ring compounds must also be present. If these hydrocarbons can be isomerized or internally rearranged into other types of hydrocarbons, the octane number of the material will be greatly increased. As an indication of the octane numbers that might be attained Table 2 shows the octane number of most of the hydrocarbons that boil in the range of 50°-300° F. An example of the isomerization reaction for one of the many hydrocarbons that might undergo such a rearrangement is:



normal heptane (Oct. No.=0) — 2.2.3- trimethyl butane (Oct. No. =101)

The improvement from 0 to 101 octane number justifies a lot of attention because 100-octane fuels are vital in our war effort and will continue to be important after the war is over.

Almost any chemical reaction is theoretically possible but the extent to which it will proceed and the rate at which it will occur, are important factors. The first of these can be studied by thermodynamic computations utilizing the free-energy content of the hydrocarbons. Thermodynamics is of little help with regard to the second factor, i.e., the rate of speed of the reaction, but a thermodynamic study does permit the elimination of highly improbable reactions and points to the proper temperature range for conducting the reaction.

Thermodynamics of isomerization.—A ther-

TABLE 2—OCTANE NUMBER OF HYDROCARBONS IN THE BOILING RANGE OF NAPHTHA
(Physical Properties of Principal Hydrocarbons—The Texas Company)

	B.P. °F.	Octane No. Research	Motor
1. Isobutane	14	100	99
2. Butane	31	95	91
3. Neopentane	49.3	...	83
4. Isopentane	82.4	91	90
5. Pentane	97	58	64
6. Cyclopentane	121	100	...
7. Neohexane 2,2-dimethyl	121.5	...	95
8. 2,3-dimethyl butane	136.3	...	95
9. Isohexane	140.4	...	73
10. 3-methyl pentane	145.8	...	74.5
11. Hexane	155.8	34	59
12. Methyl cyclopentane	161.2	81.5	82
13. 2,2-dimethyl pentane	174.7	...	93
14. Benzene	176.2	100	97
15. 2,4-dimethyl pentane	177.4	...	90
16. Cyclohexane	177.4	...	87
17. 2,2,3-trimethyl butane	177.8	...	101
18. 3,3-dimethyl pentane	186.8	...	83.5
19. 2,3-dimethyl pentane	193.5	88.5	85
20. Isoheptane	194	...	64
21. 1,3-dimethyl cyclopentane	195.3	72	...
22. 3-methyl hexane	197.2	...	65
23. 3-ethyl pentane	199.9	62	...
24. Heptane	209.1	...	...
25. 2,2,4-trimethyl pentane	210.6	100	100
26. Methyl cyclohexane	214.2	...	71
27. Ethyl cyclopentane	217.6	62	...
28. 2,2,3,3-tetramethyl butane	223.6	...	103
29. 2,5-dimethyl hexane	228.7	...	52
30. 2,2,3-trimethyl pentane	230.4	...	100.2
31. Toluene	231.4	100	100
32. 2,3-dimethyl hexane	240.3	...	75.5
33. 3,4-dimethyl hexane	241.7	...	84.5
34. 3-methyl heptane	246.4	...	34.5
35. 3-methyl 3-ethyl pentane	246.6	...	90.5
36. 1,4-dimethyl cyclohexane (cis)	256.3	74	...
37. 1.3-dimethyl cyclohexane (cis)	256.8	77	...
38. Octane	258.1	...	–28
39. 1,2-dimethyl cyclohexane (cis)	266	86	...
40. Ethyl cyclohexane	268.9	58	...
41. Ethyl benzene	277	100	96
42. *m*-xylene	278.6	100	100
43. *p*-xylene	281.1	100	100
44. *o*-xylene	291.2	100	100
45. 1-methyl 3-propyl cyclopentane	296.6	31	...
46. Nonane	303.3	...	–28

TABLE 1—NAPHTHA CONTENT OF CRUDE OIL—FOR ISOMERIZATION
(Computed from Page 72 in Petroleum Refinery Engineering, 2d ed., McGraw-Hill)

Boiling to, deg. F.—	Approx. octane number	Average (butane free) per cent of material in gasoline: Naphtha	Paraffin	Mixed	Approx. per cent of material in average crude oil: Paraffin	Mixed
160	56-70	8.5	10.0	13.5	3.6	4.2
200	53-68	15.0	18.5	24.5	6.6	7.6
250	50-65	27.5	36.0	41.0	13.0	12.7
300	47-62	41.5	51.0	55.5	18.4	17.2

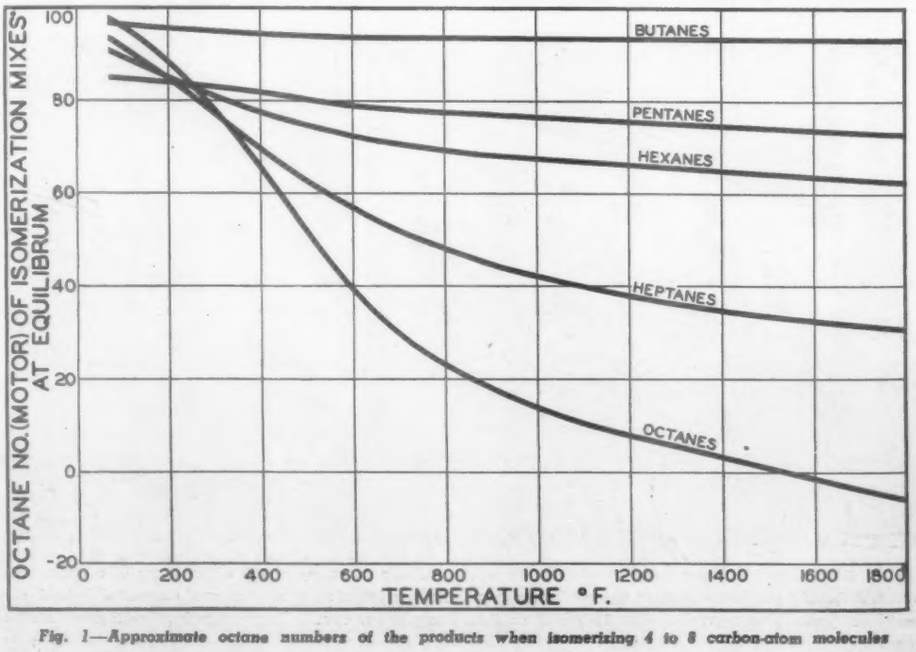


Fig. 1—Approximate octane numbers of the products when isomerizing 4 to 8 carbon-atom molecules

[1]Ethyl Gasoline Corp. fellowship, University of Tulsa.
[2]Head of department petroleum refinery engineering, University of Tulsa.

100 OCTANE GASOLINE

for the 6TH PLANE

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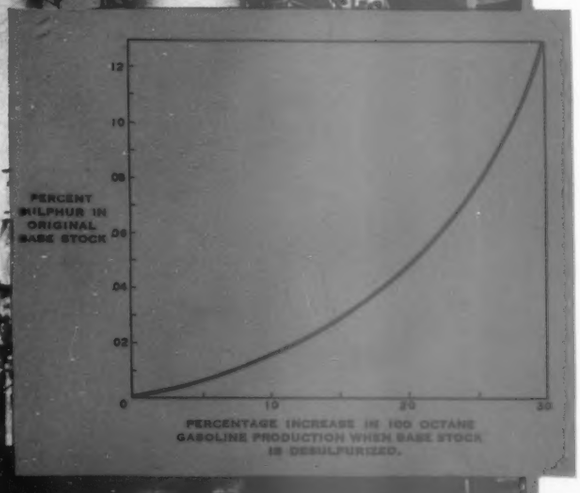
from a given amount of Alkylate . . . . with Catalytic Desulfurization of Base Stocks*



The quickest and least costly means of increasing the production of 100 octane aviation gasoline is Catalytic Desulfurization of Base Stocks.

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Processing yield is 99%; investment cost $60 to $80 per barrel. The process is simple; operating costs are low.

Desulfurization is required even where sulfur content appears low, as the adverse effects of sulfur compounds upon lead susceptibility, treating agents and inhibitors is relatively greatest at low concentrations. (Curve based on 3cc T.E.L. For 4cc T.E.L. multiply percentage increase of 100 O.N. by 1.6)

The Catalytic Desulfurization Process is an important contribution to National Defense and a material aid to refiners in meeting the demands of a greatly expanded plane construction program.

**The Catalytic Desulfurization Process, developed by Phillips Petroleum Company, is available by license through The Lummus Company.*

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TABLE 3—COMPOSITION OF PRODUCTS OF ISOMERIZATION FOR 4 TO 8 CARBON-ATOM MATERIALS

	(Mol per cent)								
	100° F.	300° F.	500° F.	700° F.	900° F.	1,100° F.	1,300° F.	1,500° F.	1,700° F.
Butane mixtures									
n-butane	35	52	61	68	72	74	76	77	79
i-butane	65	48	39	32	28	26	24	23	21
Pentane mixtures									
n-pentane	6	19	32	42	49	54	58	60	63
i-pentane	33	46	50	47	43	40	38	37	34
neo-pentane	61	35	18	11	8	6	4	3	3
Hexane mixtures									
n-hexane	6	24	45	55	60	63	67	73	80
2,3-methyl pentane	15	25	23	21	24	24	23	19	15
neo-hexane	44	22	9	5	4	4	3	2	1
2,3-dimethyl butane	35	29	23	17	12	9	7	6	4
Heptane mixtures—									
n-heptane	1	9	21	31	39	45	49	53	55
2,2- or 3,3- dimenthyl pentane	22	19	14	10	7	5	4	3	3
2,3- or 2,4-dimenthyl pentane	17	26	23	19	16	13	11	10	9
3-ethyl pentane and 2- or 3-methyl hexane	8	23	32	35	35	35	34	33	32
2,2,3-trimethyl butane	52	23	10	5	3	2	2	1	1
Octane mixtures—									
n-octane	1	8	29	45	52	58	62	66	68
3-ethyl hexane 2,3- or 4-methyl heptane	1	9	19	21	22	22	21	20	19
3-ethyl, 3-methyl pentane 2,2- or 3,3-dimethyl hexane	4	8	8	6	4	4	4	4	4
3-ethyl, 2-methyl pentane and 2,3-; 2,4-; 2,5- or 3.4-dimethyl hexane	4	11	13	12	10	8	7	6	5
2,3,3- or 2,2,3-trimethyl pentane	10	9	6	4	3	2	1	1	Trace
2,2,4-trimethyl pentane	34	33	13	4	3	2	2	1	1
2,3,4-trimethyl pentane	11	13	10	7	5	4	3	2	2
2,2,3,3-tetramethyl butane	35	9	2	1	Trace	Trace	Trace	Trace	Trace

modynamic study of the isomerization of the butane, pentane, hexane, heptane and octane hydrocarbons indicates clearly that branch-chain products of high octane number predominate if the process can be conducted at low temperatures whereas straight-chain inferior octane-number products are the predominant ones if the process is conducted at high temperatures. These relations are indicated in Fig. 1 which shows the approximate octane numbers of the products of isomerizing hydrocarbons having 4 to 8 carbon atoms per molecule. Thus, (Fig. 1) when a mixture of 8 carbon-atom (octanes) molecules are isomerized at 1,000° F. the products will exhibit an octane number of about 14 whereas isomerization at 100° F. yields a product of 96 octane number. These products result without respect to the octane number of the feed stock, so that a 50 octane number feed stock would tend to be decreased to 14 if isomerized at 1,000° F., or to increase to 96 if isomerized at 100° F.

Another way of showing the results of isomerization is indicated in Fig. 2 which shows the approximate percentages of the isomeric hexanes that are produced by isomerization at temperatures ranging from 0 to 2,000° F. This figure indicates that the percentages of 2.2-dimethyl butane (neohexane) in the product increases from 5 per cent if the isomerization occurs at 900° F., to 51 per cent if the isomerization is conducted at 100° F. The fact that neohexane is formed in relatively large amounts (30 per cent per pass) at 950° F. in thermal alkylation processes (neohexane process) is not necessarily at variance with the above statements because the speed of the alkylation reaction in the neohexane process is exceedingly rapid and probably greatly exceeds the rate at which the isomerization of neohexane into hexane, etc., takes place. Similar data to that shown in Fig. 2 is given for other hydrocarbons in tabular form in Table 3.

Method of Computation—The method used in computing the equilibrium mixtures which result by isomerization (Fig. 2) will be shown here but it is beyond the scope of this paper to discuss the theory that underlies the use of free energies for evaluating chemical reactions. For more details about thermodynamic computations the reader may resort to such references as, Nelson, Petroleum Refinery Engineering, 2nd Ed., Pages 334-41, McGraw-Hill Book Co., Inc., New York; Wenner, Thermochemical Calculations, McGraw-Hill Book Co., Inc., New York, 1941; or Lewis and Randall, Thermodynamics, McGraw-Hill Book Co., Inc., New York. The free energy change of a reaction is related to the composition of the products by the following equations:

$$\Delta\,^\circ F. = -RT\ 1nK$$

where $\Delta\,^\circ F.$ = standard free energy change of reaction
T = absolute temperature
K = mass law equilibrium constant
R = gas constant (1)

In these computations the free energies ($\Delta\,^\circ F.$) of Thacker, Folkins & Miller (Ind. Eng. Chem. 33, 584, 1941) were used although other sources such as Petroleum Refinery Engineering (McGraw-Hill Book Co.) may be used.

The conversion of butane to isobutane at 25°C. will serve as an example of the method of computation:

n-butane (gaseous) → isobutane (gaseous) (2)

The free energy change for this reaction when conducted in the gaseous phase, is:

$\Delta\,^\circ F.$ for isobutane = 3,748-4,190 = —442 (3)

Introduction of the proper values into Equation 1 gives:

$$-442 = -1.998(273 + 25)\ 1nK$$
$$K = 2.105 \quad (4)$$

The value of K for the exceedingly simple reaction indicated in Equation 2 is simply the ratio of the (gas) volume percentage of isobutane (designated as b) divided by the volume percentage of normal butane, as:

$$\frac{b}{1-b} = 2.105$$

b = 0.678 or 67.8 per cent isobutane and 32.2 per cent butane

Discussion—The interpretation of thermodynamic results must be approached with great care. The results given in this paper are for the reactions of isomerization alone and do not account for other reactions such as decomposition, alkylation, carbonization, etc., which may also occur, nor do they indicate whether the reactions will occur rapidly or whether an inordinant length of time will be required in coming to the equilibrium mixes indicated herein. Nevertheless, such isomerization as does occur will result in the distribution of isomers that is indicated in Fig. 2 and Table 3. A particularly troublesome side reaction is the formation of carbon or coke by decomposition because this reaction tends to stop the action of catalysts. Although the probability of this reaction has also been studied thermodynamically, little can be stated at this stage except that carbonization is small at low temperatures and that the smaller molecules such as butane show a lesser tendency to carbonize than large molecules such as the octanes.

Finally, the results given here are only an indication of the general tendency for the various isomerization reactions to take place. The rate of reaction will probably be very slow, particularly at low temperatures and hence the commercial application of isomerization will probably require the discovery of suitable catalysts for hastening the isomerization reactions.

Although the thermodynamic method has several serious disadvantages as injected in the above discussion, it is about the only general method that is available by which probable reactions can be selected from the vast number of possible reactions. In this light a thorough and complete mathematical study to determine free energies from existing physical data, and by free energies to discover the most probable reactions for each boiling range of petroleum, might serve as the very foundation stone upon which a petroleum chemical industry can be built. Such a study or compilation might discourage the wasting of even millions of dollars on improbable research studies, and would point the way to a more wise expending of our energies. It should be borne in mind, however, that such a program would be exceedingly laborious, and would require a high degree of judgment and skill in the interpretation of the results.

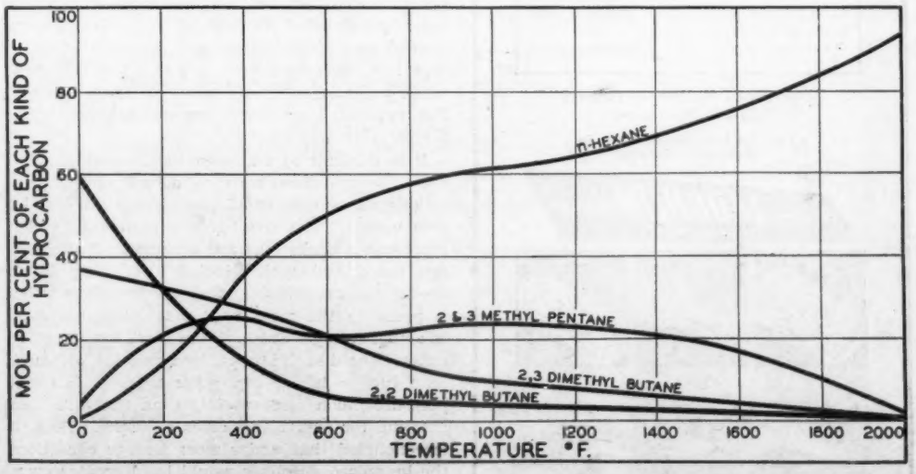

Fig. 2—Percentages of isomeric hexanes produced when any mixture of hexanes is isomerized

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Propane—A Substitute for Butane in Motor Fuels

(Continued from Page 81)

tion of Fig. 3 represents the per cent increase in TEL consumption if butane is not used. Thus if 10 per cent butane had been used in a butane-free motor fuel the increase in consumption of TEL to maintain the same octane number would be 37 per cent when the butane-free gasoline had a TEL requirement of 2.0 cc. (center graph) to the desired octane number. The TEL consumption is expressed in Fig. 3 in terms of refinery capacity to produce butane-free motor fuel. In the foregoing case the loss in motor-fuel production would be 11 per cent as indicated by the dashed line in the right-hand graph in Fig. 3. Hence if motor-fuel production is to be maintained at 100 per cent the per cent increase in TEL consumption would be greater than indicated.

The solid lines in the left three-segment portion of Fig. 3 represent the per cent increase in TEL consumption if propane is substituted for butane in proportions resulting in the same vapor pressures. Thus in the example cited above the per cent increase in TEL consumption is only 16 per cent. From the right-hand graph the decrease in production is 7.5 per cent and the per cent propane in the finished motor fuel is 2.8 per cent.

The data of Fig. 3 show that the removal of normal butane from motor fuel would bring about a tremendous increase in TEL consumption, the average being about 25 per cent. Substituting propane for butane the average increase in TEL consumption would be about 9 per cent, a substantial improvement.

Conversely the above effects in the face of an existent shortage of TEL would mean further reduction in the octane number of civilian gasoline with only about one-third the drop when propane replaced diverted butane.

Evaporation Losses

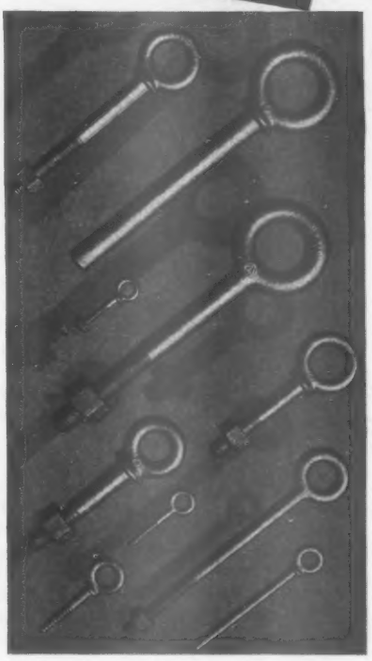
Only a few tests have been conducted to determine the relative evaporation losses. These tests have been conducted with a butane-free gasoline propanized (3 per cent) and butanized (11 per cent) to 12-lb. R.v.p.

(*a*) Standing in large graduated cylinders at about 35° F. the butanized gasoline lost 2.6 per cent (volume) while the propanized gasoline lost 1.4 per cent in 20 hours.

(*b*) In small-mouthed weighing bottles at 77° F. the butanized gasoline lost 1.35 per cent (weight) and the propanized gasoline lost 1.13 per cent in 20 minutes.

(*c*) In a variation of the Whitman vapor-pressure method[3] the propanized gasoline had a vapor pressure of 485 mm. at 0 per cent evaporation loss and 285 mm. at 5 per cent evaporation loss. The butanized gasoline had 400 mm. vapor pressure at 0 per cent evaporation loss and 370 mm. at 5 per cent evaporation loss. The temperature was 75.5° F.

It is difficult to translate the foregoing accelerated evaporation tests to actual storage conditions where only small percentages are lost by evaporation. The first two experiments which represent a single outward breathing of the storage vessel and which include the time factor are the most conclusive, since the breathing effect is probably the most important factor involved in actual storage. It is also obvious from the third experiment that the propanized gasoline, although at a higher initial vapor pressure, loses vapor pressure much more rapidly than the butanized gasoline for equivalent losses of vapor. Thus, it is concluded that under most storage conditions the butanized gasolines would have greater evaporation losses than the propanized gasolines but



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under some very special and unusual storage conditions the situation would be reversed up to losses approximating 2 per cent, after which point the butanized gasoline would suffer higher losses than the propanized gasoline.

Effect of Propane on Distillation Recovery

A review of the various specifications on motor fuels shows several states with distillation recovery specifications of a minimum of 95 per cent. Although meaningless in the light of present-day knowledge, these specifications are still in force.

The effect of propane on the per cent recovered in the distillation test (D 86-40) was determined by propanizing a series of butane-free gasolines having approximately 30, 45 and 60 per cent evaporated at 212° F. The results indicate that distillation loss is a function of the percentage of propane present, and is apparently independent of the vapor pressure or the over-all volatility of the fuel. The decrease in recovery amounts to approximately 0.3 per cent for the first 1 per cent additions, 2.3 per cent for 3 per cent propane additions, and 6.0 per cent for 6 per cent propane additions.

In general these data show that except in the range of winter motor fuels, propanized motor fuels will meet the 95 per cent minimum distillation recovery with a safe margin. However, in the range of winter gasoline, there is not much margin of safety. Any attempt to use the extra vapor-lock leeway to further restore the production, ease of starting and TEL handicaps of propanized gasolines would encounter difficulty from this archaic specification.

Conclusion

1. The nation's normal daily motor-fuel production contains about 100,000 bbl. of butane. This could be replaced by about 28,000 bbl. of propane for a product of equal vapor pressure.

2. The output of a given amount of refinery capacity would be reduced by about 6 per cent if butane were eliminated but by only 4.5 per cent with the substitution of propane.

3. "Possible starting" is obtainable at atmospheric temperatures of —33°, —25°, and —4° F. with average butanized winter, propanized winter and butane-free motor fuels, respectively.

4. "Easy starting" is obtainable at —16°, —4° and 11° F. with average butanized winter, propanized winter and butane-free motor fuels, respectively.

5. The vapor-locking fuel-line temperatures may be as much as 30° F. higher for propanized summer gasolines than for butanized summer gasolines.

6. The elimination of butane from motor fuel would raise the TEL consumption 25 per cent on the average for a given refinery capacity. If propane is substituted for butane the increased TEL consumption is only 9 per cent on the average.

7. At 4 per cent propane inclusion, approximately the maximum for winter gasolines, the A.S.T.M. distillation recovery would be uncomfortably close to the often encountered specification of 95 per cent minimum.

8. Accelerated evaporation loss tests in containers with relatively small openings show that the butanized winter gasoline loses volume faster than the propanized winter gasolines. In closed systems at equilibrium the propanized gasoline had higher vapor pressures up to about 2 per cent evaporated and lower vapor pressures thereafter.

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I.P.A.A. Meeting to Be Held At Wichita Next October

The Independent Petroleum Association of America will hold its thirteenth annual convention in Wichita, Kans., October 13-15, the executive committee voted recently. The annual meeting of the National Stripper Well Association to be held in conjunction with the I.P.A.A. convention will convene October 12. This will be the first meeting of the association in Kansas. It was decided to hold the midyear meeting of association directors in Fort Worth, Tex., the date to be selected later, to be either in April or May.

Petroleum Specialties, Inc., May Expand Crude Capacity

FLAT ROCK, Mich.—An increase of 1,000 bbl. to the daily crude capacity of Petroleum Specialties, Inc.'s refinery here, raising the plant throughput to 4,000 bbl. per day, is proposed as a 1942 project. The refinery includes a 750-bbl. cracking unit.

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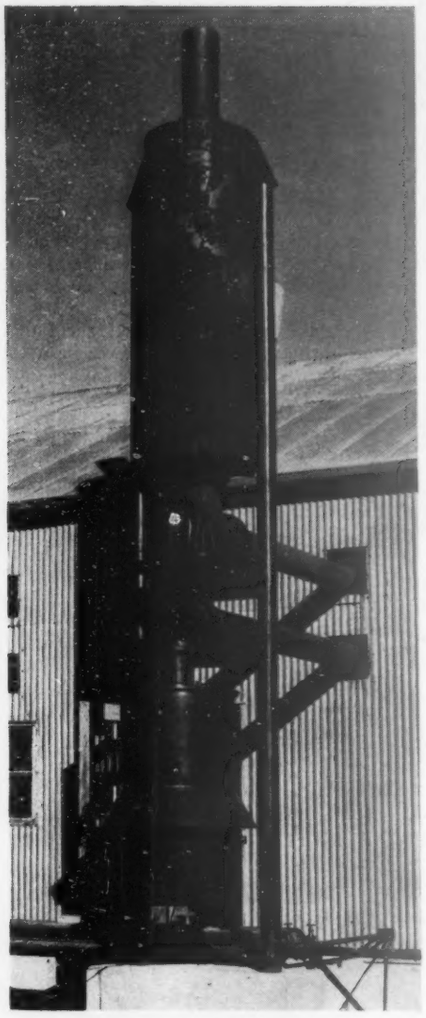
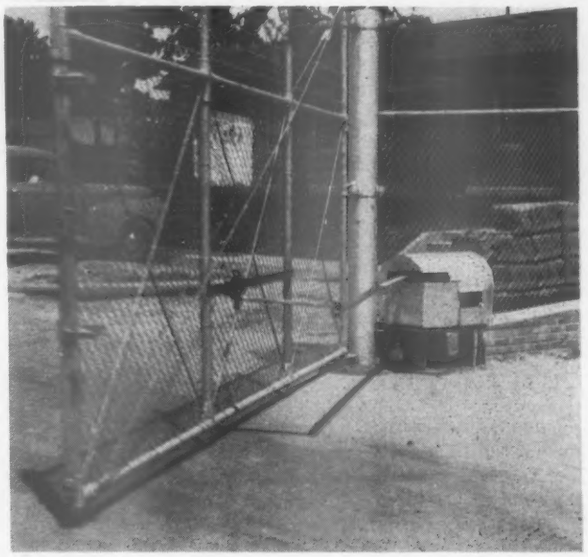
Refinery IDEAS ... that save $ $ $



Watchman Opens Truck Gate Without Going Outside

By means of a small electric motor directly geared to a flat, horizontal, eccentrically mounted steel plate the front gate at a refinery can be opened and closed through an arm extending from the plate to the gate. A short, swinging joint between the gate and the long arm equalizes the difference between the radii of the gate and the arm. Obviously, the leverage on the gate at the end of the arm is not great and for this reason the gate must be mounted to swing freely, but this small leverage is also an advantage. Because of this, there is less chance of anyone being hurt if a person should be caught between the end of the gate and the post against which it closes. The motor is reversible. There is sufficient friction in the system to hold the gate securely in place when the gate is not being moved by the motor. →

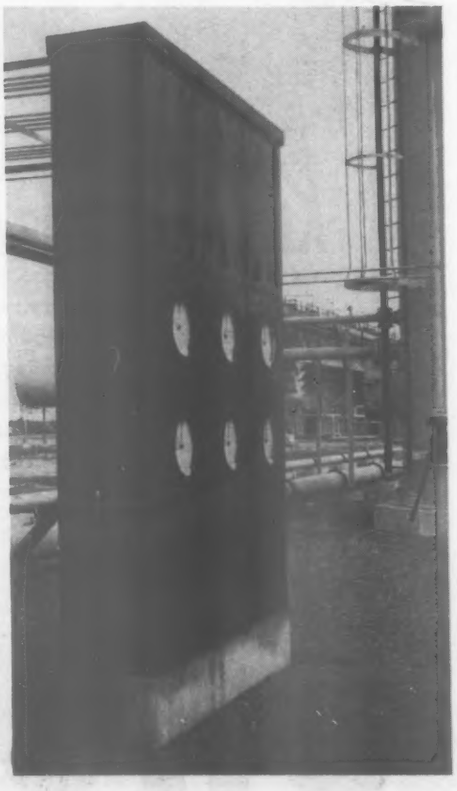


One Support Accommodates Air Filter and Exhaust ↑

Two 6-in. pipes imbedded in concrete provide the supports for the air filter and the exhaust muffler serving each large engine at this plant. The supports are tied together with stringers welded vertically to each support and resting on this and welded to the supports are the plates upon which the filter and the muffler rest.

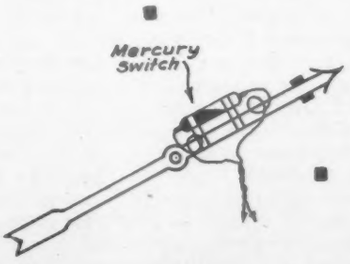
Steam Coil Keep Heaters Warm in Outside Location →

The installation of recording meters and indicators of various types can usually be made most economically in buildings located near the units served. This also has the advantage of cutting down the resistance of the lead lines or the "drag" on the lines between the meter and the unit. But a building is not always available in the location most desirable for the efficient operation of the meters. One company handled such a problem by erecting an outside meter panel with a boxed rear panel and steam coils.

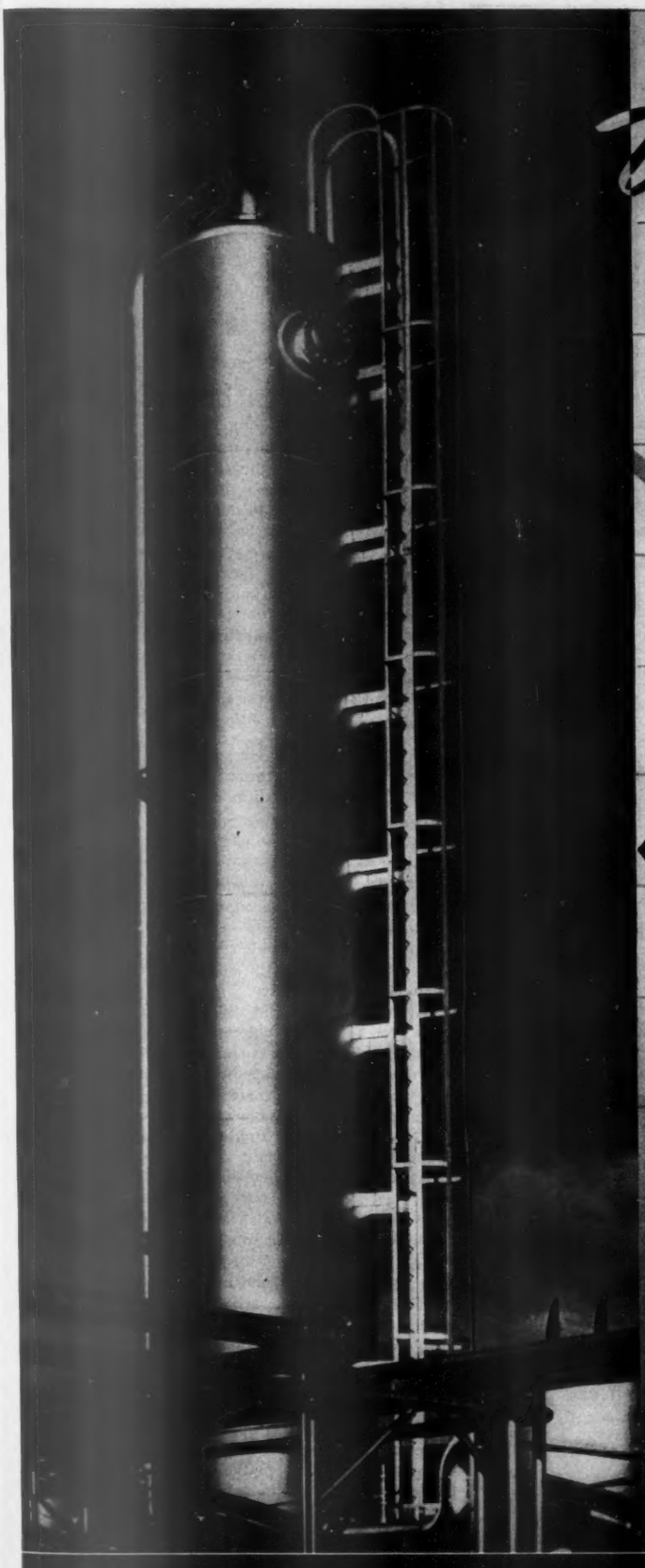


Mercury Switch Warns Against Water Pressure ↓

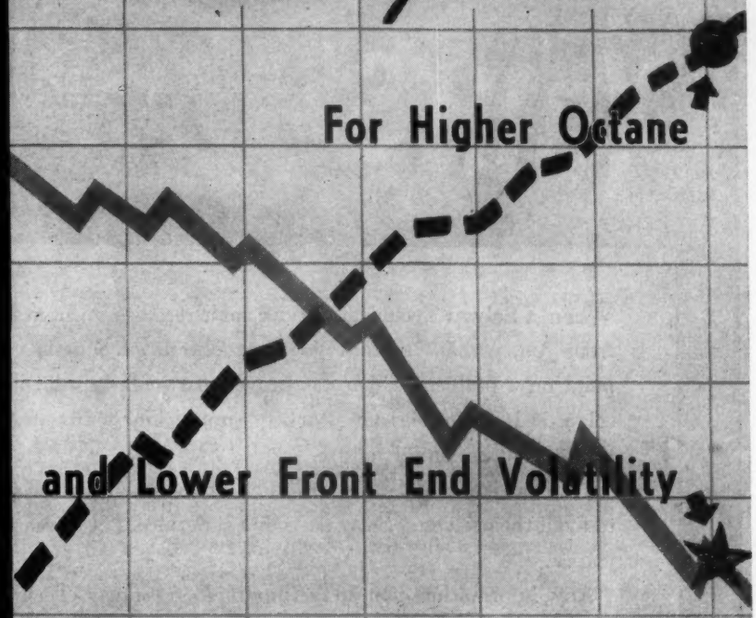
The water pressure on a line going to the cooler on a distillation unit is indicated by the partial revolution of an indicator hand. The installation has been made foolproof against serious water-pressure reduction by mounting a mercury switch



on the arm of the indicator. When the arm is in the vertical position, the mercury remains at one end and there is no electrical contact. When the arm reaches a horizontal position, the mercury makes a contact across the tube and causes a warning bell to ring. Obviously, this type of warning can be applied in many places whether to indicate excessive pressure, temperature, or some other factor.



Use WARREN'S Natural Gasoline



As demands increase for quality and supply in all fields of national defense and domestic production, refiners are realizing the *added* advantages of blending with Warren's Stabilized Natural Gasoline. Now, as never before, "natural" is the safe, sure way to insure quicker starting, higher Octane rating of motor fuel, in view of shortage of Ethyl lead.

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Are We on the Threshold of a Petroleum Chemical Industry?

(Continued from Page 85)

B. Polymerization—Connection of two olefin molecules (see 1.A.) to form a single larger molecule, usually of a reactive variety.

$$\underset{\text{ethylene}}{C_2H_4} + \underset{\text{butylene}}{C_4H_8} = \underset{\text{hexene (as in poly gasoline)}}{C_6H_{12}}$$

C. Hydrogenation—Addition of hydrogen.

$$\underset{\text{hexene}}{C_6H_{12}} + \underset{\text{hydrogen}}{H_2} = \underset{\text{hexane}}{C_6H_{14}}$$

Only rarely does a commercial process function by a single one of the above chemical operations. In some instances several useful chemical reactions can be accomplished at the same time in a single commercial process such as splitting and isomerization in the Houdry catalytic cracking process, but more often, undesirable side reactions which tend to defeat the main purpose of the process cannot be entirely avoided. Such is the case in our regular cracking processes wherein splitting and isomerization are desired, but unfortunately carbonization (coking), polymerization (cracked fuel oil), and gas formation by too vigorous a splitting reaction, also take place. Thus in regular cracking we produce gas, fuel oil and troublesome coke as well as the gasoline which we desire. It should be noted that the same difficulties arise in nearly all commercial operations.

Vital Importance of Isomerization, Dehydrogenation and Cracking

Although all chemical reactions can from a theoretical standpoint be practiced on any of the hydrocarbons (or mixtures of them) that are found in petroleum such an approach is not practical because of economic and other considerations. There are, however, three fundamental types of reactions which underlie the present optimism concerning the development of a petroleum chemical industry. These are the dehydrogenation, splitting and isomerization reactions. The first of these, dehydrogenation, is vitally important because it permits the conversion of the unreactive materials normally present in oil into materials which are highly reactive from a chemical standpoint or can be used for the synthesis of literally hundreds (or perhaps thousands) of new materials. Among these new materials are synthetic rubber, alcohol, medicines, preservatives, explosives, paints, varnishes, lacquers, plastic materials, anaesthetics, synthetic vegetable and animal oils, wood alcohol, perfumes, essential oils, formaldehydes, synthetic fats, and perhaps to such now unlikely materials as foods, large scale structural materials, and clothes. It must of course be realized that such developments must advance under their own power and in the face of economic competition.

The other vital reactions are isomerization and splitting. Isomerization permits a rearrangement of the carbon and hydrogen atoms into products of greater usefulness, as the production of toluene from normal heptane, or the conversion of normal heptane (octane number of 0) into the highly antiknock material 2,2,3- trimethyl butane having an octane number of about 100. Likewise splitting (the main reaction of cracking) permits the conversion of high-boiling oils such as residuum into lower-boiling oils such as gasoline. The other chemical reactions should not, however, be dismissed as unimportant because they too fill a widespread need.

Importance of Bulk Charge Stocks

The somewhat arrested state of the industry today with respect to the developments of a true large-scale chemical industry is evident in

the charge stocks that have heretofore been employed. These charge stocks, with the exception of those for cracking, have been pure hydrocarbons or relatively simple mixtures. Such charge stocks have been available in relatively small amounts or have involved somewhat costly methods of purification. Chemists have naturally turned to pure charge stocks such as butane or propane not alone because they could be obtained in the pure form, but also because the products from such charge stocks are relatively few and could be identified with ease. The condition is vastly more complicated when a mixture is used as a feed stock; firstly the chemicals in the feed stock cannot be easily identified nor their behavior evaluated; and secondly, what may happen in the process cannot be easily understood because of difficulty in identifying the chemicals which compose the products.

Nevertheless, the use of bulk charge stocks rather than pure hydrocarbons, now appears to be generally possible, and in fact is being practiced in connection with the processes of cracking, catalytic cracking, polyforming (and hydroforming), destructive hydrogenation, and the Isomate process. In all of these processes, wide-boiling-range charge stocks may be employed but the charge stock for the Isomate process is at present limited to a range of 60-160° F. (pentanes and hexanes). The fact that we are now accumulating enough skill to apply the general chemical reactions to mixtures as well as pure hydrocarbons is strong proof that the petroleum chemical industry will rest on a sound economic foundation.

Thermodynamics in Evaluating Charge Stocks

There are several general methods by which the suitability of various charge stocks can be evaluated, but for mixtures a thermodynamic study based on the free energies of each of the hydrocarbons that are present, is an extremely useful method. The completion of such studies to include all types of reactions and to cover the entire boiling range of petroleum is an enormous task but it would prove to be a valuable foundation for the development of a petroleum chemical industry.

One such study, applied to the isomerization of butane, pentane, hexane, heptane, and octane is given on Page 120 of this issue of The Oil and Gas Journal. The study indicates clearly that the products of low temperature isomerization processes should be highly branched-chain materials of high octane number. Thus the octane number of the material produced when hexane is isomerized at 900° F. is about 68 whereas the octane number would be about 90 if the process were conducted at 100° F. A somewhat similar study but applied to the alkylation of propane and isobutane is computed in detail on Pages 336-41 of the second edition of Petroleum Refinery Engineering (McGraw-Hill Book Co., Inc., New York, 1941). This study indicates that the obtainment of high octane number products by alkylation is also facilitated by low temperatures.

●

Asphalt Still Added At Kansas Refinery

GARDEN CITY, Kans.—A blown asphalt still is under construction at the Shallow Water, Kans., refinery operated by the Shallow Water Refining Co. of this city.

The refinery consists of topping equipment to process 2,000 bbl. of crude daily and a 250-bbl. cracking plant. The company is headed by J. B. Allison, chairman, and Morten Brown, president. V. F. Benest is refinery superintendent, and William Borner is assistant.

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Butadiene Is Real Bottleneck in Synthetic-Rubber Program

By J. P. O'DONNELL

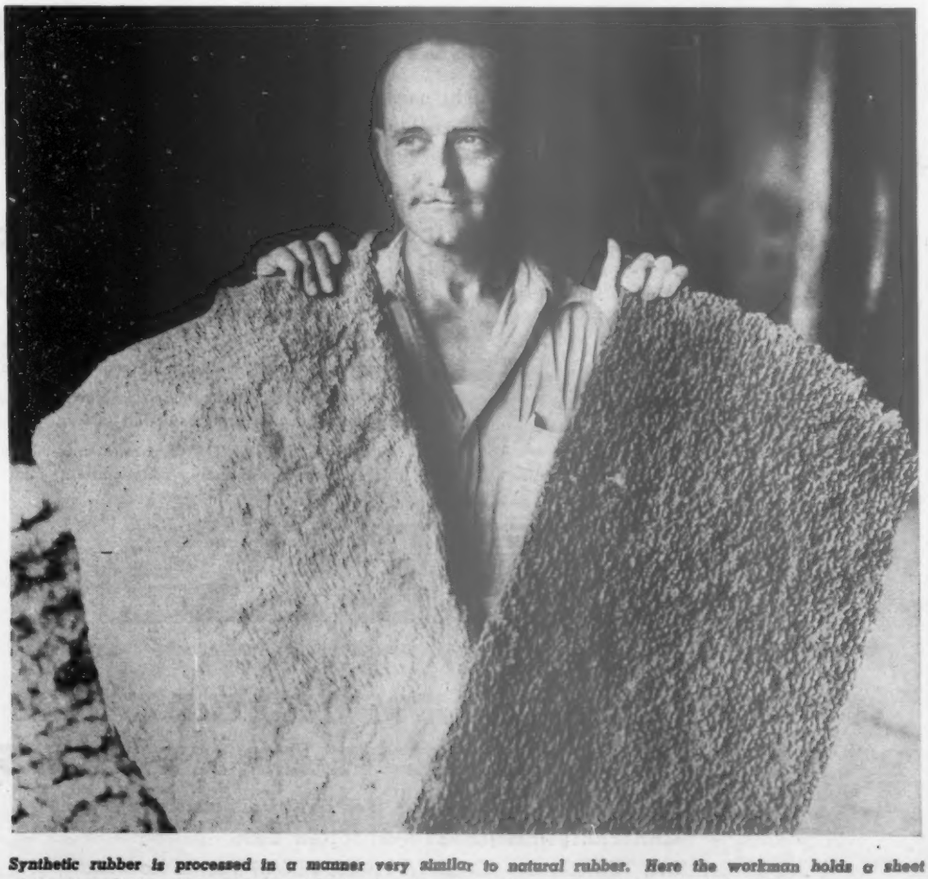
PRODUCTION of a third vital war material outside its normal scope of operations has been assumed by the refining industry in its undertaking to provide butadiene and copolymers for the manufacture of synthetic rubber. Previously it had practically guaranteed to supply all the needs of the United Nations for 100-octane aviation gasoline, a product which was produced in negligible quantities up to a short time ago and toluene, a product normally recovered only in byproduct coke operations.

100-Octane Program

When the 100-octane gasoline program reaches its projected goal of 250,000 bbl. per day, the United States will be producing at the rate of 91,250,000 bbl. annually. The rate of toluene production from petroleum in plants now operating or under construction is said to be 1,700,000 bbl. per year. When the synthetic rubber program reaches its peak of possibly 500,000 tons, including polysulfides and chloroprenes, per year it is estimated that it will require production of butadiene at an annual rate of no more than 3,750,000 bbl. Thus from a volume of production standpoint it is apparent that the requirements of the synthetic rubber program will be minor in relation to the demands of the high-octane gasoline program.

The sudden assumption of the responsibility of producing raw materials for synthetic rubber on the refining industry did not find organizations totally unprepared. A vast amount of research had already developed the required processes and two oil companies, Standard Oil Co. of New Jersey and Phillips Petroleum Co., were already in the production of such material on a commercial basis. Cooperating in this work were the major rubber companies and several chemical companies. As a result the processes are immediately available for producing many kinds of synthetic rubber. Twenty-nine varieties are listed by Lawrence A. Wood in Bureau of Standards Circular C-427.

By far the greatest volume of synthetic rubber being produced in the world today is manufactured from products available from petroleum. Since the United States produces 65 per cent of the world's petroleum it follows that this country is, potentially, the greatest producer of synthetic rubbers. Dr. Gustav Egloff, director of research, Universal Oil Products Co., has estimated that "over 200,000,000,000 lb. of synthetic rubber could be produced from ethylene from the cracking process, benzene from cyclization and butadiene from the dehydrogenation of butane." United States consumption of rubber was greatest in 1941 when it averaged 60,000 tons per month, so it is evident that ample raw materials are available to make this country entirely self-sufficient.



Synthetic rubber is processed in a manner very similar to natural rubber. Here the workman holds a sheet of dried synthetic rubber with his right hand and a sheet of natural rubber in his left. Neither has been vulcanized but they could be processed further in almost identical manner

Foreign Production

Germany and Russia are both far ahead of us in the production of synthetic rubber but neither has the raw resources that are available here. Before the war Germany knew that she would have to be self-sufficient from the rubber standpoint and accordingly has increased her production to an estimated 100,000 tons per year. The United States Department of Commerce reported Russian capacity at 50,000 tons per year in 1939, a figure which has probably changed little since. Germany's principal plants are located at Schkopau and Huls, each of which has a capacity of 25,000 tons per year.

Synthetic rubber was produced for the first time commercially in this country in 1930 by the Thiokol Corp. It was followed a year later by the introduction of Neoprene by E. I. du Pont de Nemours & Co. Thiokol is produced by the reaction of an organic dihalide with sodium polysulfide in an aqueous solution. Neoprene is made by the polymerization of 2-chlorbutadiene which was made by the addition of hydrogen chloride to monovinylacetylene in the presence of a cuprous chloride catalyst. Both of these were produced independently of the petroleum industry though some of the raw materials involved are obtainable from petroleum.

The possibility of the large scale utilization of the petroleum derivative, butadiene, was opened by the German discoveries of Buna S which has been produced there since 1935 by I. G. Farbenindustrie A. G. and of Buna N of Perbunan which was announced by the same company in the same year. Germany however does not utilize butadiene obtained from petroleum but produces it by a highly involved process starting with coke and lime. These products produce calcium carbide from which acetylene is obtained. Acetaldehyde is produced by passing the acetylene into dilute sulfuric acid containing a mercury catalyst. The acetaldehyde is converted to aldol by means of dilute alkali and the aldol is dehydrogenated under pressure at 100°C. in the presence of a nickel catalyst to produce butylene glycol from which butadiene is obtained by dehydration.

Russia likewise obtains butadiene from sources other than petroleum, though employing a process that is far simpler than that used in Germany. Ethyl alcohol is produced by the fermentation and distillation of grain or potatoes, vaporized and passed over an aluminum-zinc oxide catalyst at 400° C. The product of this reaction is butadiene.

Availability of large quantities of butane in the United States make it the logical starting point for the production of butadiene here. It has been estimated by W. L. Nelson (The Oil and

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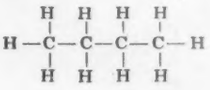
Gas Journal, Jan. 22, 1942, p. 10) that 129,000 bbl. of butane per day are available here. He lists the following potential sources: "60,000 bbl. from motor fuels by providing less volatility and by a probable decrease in motor-fuel demand during several years; 5,000 bbl. by curtailment of certain nonessential liquefied-gas sales: 17,000 bbl. now lost by burning in gasoline plants; 32,000 bbl. lost in residue gases from gasoline plants; 10,000 bbl. by installation of more recovery systems in small refineries, and 5,000 bbl. by processing more gas or building more natural gasoline plants. A small amount (perhaps 15,000 bbl. per day) of butanes (or butenes) could also be produced by the polymerization of cracking still gases such as ethylene and propylene but the cost would be high."

Butane Needs

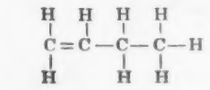
The 400,000-ton per year goal recently announced by Jesse Jones of the RFC is the weight equivalent of 11,000 bbl. per day of butane, Mr. Nelson states. More will be needed because of conversion losses and a conservatively large figure of 45,000 bbl. per day is estimated.

Butadiene is obtained from butane by converting the paraffin to an olefin and by converting the olefin to the diolefin, butadiene. Chemically, the conversion may be described as follows:

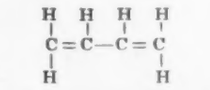
Butane:



Butylene:



1,3-butadiene:



Butadiene, a gas at temperatures above —5°C., is obtained directly by the dehydrogenation, either thermally or catalytically, of olefins which may, in turn, be obtained by dehydrogenation of butanes. There are a number of such processes in operation or under construction. A catalytic dehydrogenation process has been described by Grosse, Horrell and Mavity of Universal Oil Products Co. (I. & E. C., 32 309, 1940). Catalysts of the chromium, molybdenum or vanadium oxide-on-alumina type are employed at low pressures and at 600-650° F. for the production of butadiene and isoprene from butenes and branched pentenes. By the use of recycling, yields of as high as 79 per cent from butene and 65 per cent from butane have been reported. Catalytic cracking of gas oils will also be used for the production of olefins.

A comparison of the Russian, German and probable American processes for obtaining butadiene is given in the accompanying Fig. 1 (Russia-Germany from W. C. Goggins, A.P.I. April, 1941). Germany's involved process is necessary because she lacks the grain and potatoes used in the Soviet method and because she must conserve what little gases are obtained from petroleum in Germany.

Fig. 1

United States:
Butane → (dehydrogenation) → butylene → (dehydrogenation) → butadiene.

Russia:
Grain or potatoes → (fermentation and distillation) → ethyl alcohol butadiene.

German:
Coke, lime → acetylene-plus water → acetaldehyde → aldol-plus hydrogen → butylene and glycol → butadiene.

A list of the principal types of synthetic rubbers has been prepared by Dr. Harry Barron (Rubber Age, April, 1941). There are a variety of others but the principal ones, including those which will be produced under the defense program and those which are produced by the leading domestic manufacturers, are included in the following list:

Type—	By—	Composition—Polymers of	Raw materials—
Neoprene	Du Pont	chloroprene	carbide
Thiokol	Dow	ethylene polysulfide	
Perduren	I. G. Farbenindustrie	ethylene polysulfide	
Buna 85	I. G. Farbenindustrie	butadiene	carbide
Buna S	I. G. Farbenindustrie	butadiene+styrene	carbide and coal
Perbunan	I. G. Farbenindustrie	butadiene+acrylonitrile	carbide and coal
Chemigum	Goodyear	butadiene+acrylics	oil waste and coal
Hycar	Goodrich with Phillips Petroleum	butadiene+acrylics	oil waste and coal
Bunas	Standard Oil (N. J.) Firestone U. S. Rubber	butadiene+acrylics	oil waste
Butyl	Standard Oil (N. J.)	olefins+diolefins	oil waste
Vistanex	Standard Oil (N. J.)	isobutylene	oil waste
Oppanol	I. G. Farbenindustrie	isobutylene	carbide

In a generic sense there are five types of so-called synthetic rubbers in relatively large scale commercial production. They are (1) polymerized butadiene, (2) Buna S, (3) Buna N or Perbunan, (4) polysulfides (Thiokol), and (5) Neoprene. Russia is now the sole manufacturer in quantity of polymerized butadiene which Germany abandoned several years ago in favor of the more versatile copolymer types, Bunt S and Buna N. Butadiene is polymerized by holding it at a slightly elevated temperature for a period of several days in the presence of metallic sodium which serves as a catalyst. Synthetic rubber produced by this method is inferior to natural rubber and to most other synthetics. It is best suited for uses where hard rubber is required.

Styrene as Copolymer

Buna S is produced by the copolymerization of butadiene and styrene. These constituents are emulsified in water with soap or a synthetic emulsifying agent and the emulsion held at slightly elevated temperatures until polymerization is complete. This type will be produced in the government plants now under construction. When compounded with carbon black it is reported to be far superior to natural rubber from the standpoint of heat and abrasion but its solvent resistance is no greater. A representative Buna S tire is reported to have 35 per cent greater abrasive resistance though it is inferior in tensile strength and elasticity to a tire manufactured from natural rubber. It is also the least expensive of the major synthetics available for tires, the field in which 75 per cent of our rubber is normally consumed.

Because of the current importance of Buna S in the synthetic rubber program, a separate table comparing its characteristics with those of natural rubber is given. It should be remembered in this and in other instances where comparisons are made that no valid generalizations may be made regarding the qualities of generic types because each is capable of considerable variation depending on the proportions of the polymerizable intermediates, the polymerization environment and the conditions under which they are vulcanized. Two other important considerations are (1) conditions under which comparative tests are made and (2) laboratory results are not always confirmed by performance tests. With regard to the first it is pointed out that a tire which gives the best service on a slow-speed taxicab in a metropolitan area, for example, will not give the best service on a car operating at high speed on open roads. Temperatures, speeds, type of road surface, etc., are factors affecting tire service.

Buna N (Perbunan) is made by the copolymerization of butadiene and acrylonitrile (vinyl cyanide). Its superiority over natural rubber is greatest in its resistance to deterioration by oils or solvents and, in view of these characteristics, is regarded as having an attractive future regardless of the resumption of competition between natural and synthetic products. As in the case of Buna S the ratio of the copolymers may vary with a corresponding variation in the properties of the product.

Neoprenes are superior to natural rubber in resistance to deterioration by sunlight, heat and oils and are much less inflammable because of their chlorine content. In many respects their properties are quite comparable to those of natural rubber whether vulcanized in a pure gum state or compounded with carbon black for tires. The U. S. Army has been using neoprene tires to some extent since 1934. Neoprenes are made by the polymerization of chlorbutadiene (chloroprene). Monovinylacetylene, product of the condensation of two molecules of acetylene, is added to hydrogen chloride in the presence of a cuprous chloride catalyst to produce chlorbutadiene

(Continued on Page 134)

CHARACTERISTICS OF BUNA S AND NATURAL RUBBERS

Property—	Buna S Rubber	Natural Rubber
Tensile strength (lbs. sq. in.)*	4,200	5,000
Elongation (per cent)	650	650
Specific gravity	0.98	0.92
Resistance to deflection	better	good
Permanent set (after stretching)	poorer	good
Compression set	good	good
Abrasion resistance	better	good
Tear resistance	good	good
Resistance to air, light, heat	good	fair
High temperature resistance	good	fair
Resistance to swelling (solvents)	fair	fair
Corrosive chemicals resistance	fair	fair
Water resistance	excellent	good
Electrical properties	good	good
Elasticity and hysteresis loss	poor	good
Flexing	excellent	good
Flame resistance	nil	nil
Color	o. k.	o. k.
Odor	persistent	dies
Adhesion	satisfactory	satisfactory
Reclaiming	probably o. k.	fair
Hardness	good	good

*Vulcanized carbon black compound.

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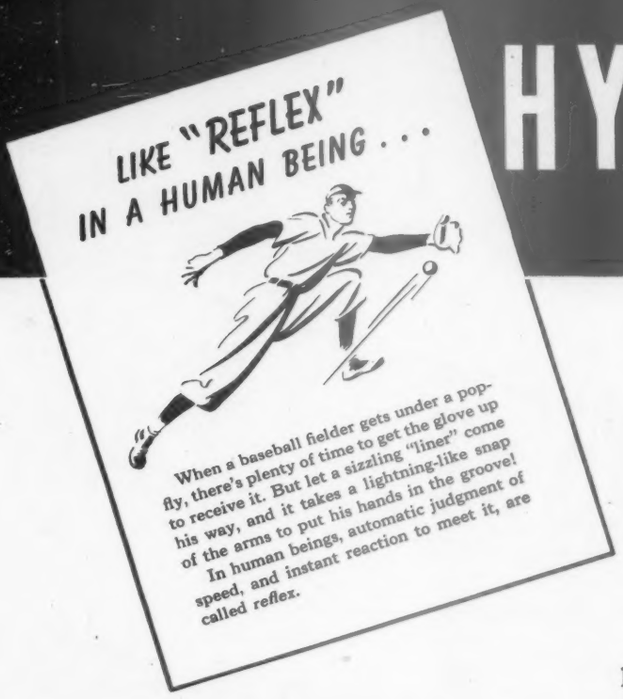
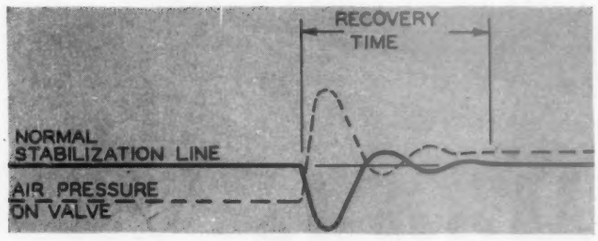
BRADEN STEEL

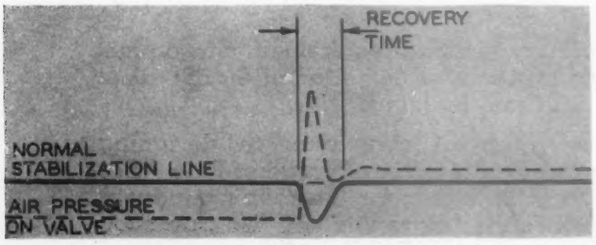
HYPER-RESET


LIKE "REFLEX"
IN A HUMAN BEING . . .
When a baseball fielder gets under a pop-fly, there's plenty of time to get the glove up to receive it. But let a sizzling "liner" come his way, and it takes a lightning-like snap of the arms to put his hands in the groove! In human beings, automatic judgment of speed, and instant reaction to meet it, are called *reflex*.

Automatic Rate-Sensitive Action Stabilizes Upsets Quicker



This curve is typical of the results obtainable from good Proportional Control with Reset, before the development of HYPER-RESET. It shows recovery from one arbitrarily-chosen upset.



Here is the recovery curve for the same upset, when HYPER-RESET is added to Proportional Control. Because stabilization is accomplished in one-*fourth* the time, the proportional band can be safely cut in *half*. This is Model 30 Stabilog Control!

Foxboro's introduction of automatic reset action marked a revolutionary improvement in automatic control. HYPER-RESET represents a new advance that is even more outstanding!

HYPER-RESET stabilizes upsets quicker than anything previously available. It is reset *plus* automatic rate-sensitive action, . . . it produces valve-action automatically augmented in proportion to the rates of change of any disturbance.

HYPER-RESET not only gives smoother recovery in *one-fourth* the usual time, but also reduces the magnitude of every upset at least *fifty per cent*. It gives *Performance* with *Stability* on the toughest control problems.

What's more, such results are obtained without *any* additional adjustments!

Only two adjustments are necessary. One sets the proportional band; the other, HYPER-RESET, selects both the correct reset and proper rate-sensitivity.

These two easy adjustments on the Model 30 Stabilog Controller are now simpler, quicker and surer . . . saving time as well as producing smoother, closer processing.

Biggest Advance in Control Since Automatic Reset!

Write for Useful DEMONSTRATOR!

Here's a printed "working model" of the Model 30 Stabilog Controller that enables you to see just what happens to the control curve with varying amounts of proportional band setting and HYPER-RESET. It shows the resulting curves from any set of adjustments you may choose to make.

Write for one of these new patented Foxboro Control-Adjustment Demonstrators and Bulletin A330.

Get the Full Story

A detailed discussion of the new Model 30 Stabilog Controller with HYPER-RESET is presented in Bulletin A330 now on the press. Reserve your copy today! Also ask for one of the unique new Foxboro Control-Adjustment Demonstrators shown at right. **The Foxboro Company, 60 Neponset Ave., Foxboro, Massachusetts, U.S.A.**

FOXBORO

which is polymerized by emulsification in water in a few hours.

The chemistry involved in the polymerization processes discussed in the foregoing paragraphs was illustrated as in Fig. 2 by E. R. Bridgewater, manager, rubber chemicals division, E. I. du Pont de Nemours & Co. at the annual meeting of the Franklin Institute.

Polysulfide rubbers are made by condensation instead of polymerization and thus are distinct. They are a product of the condensation reaction of organic dihalides with sodium tetrasulfide. Polysulfide rubbers are outstanding among the synthetics in their resistance to swelling by oils, particularly aromatic hydrocarbons, and are resistant to oxidation deterioration. They are produced in Japan as well as in this and other countries.

These by no means completely cover the synthetic rubber field. Among the others there are Butyl, compounded principally of olefins with a small amount of diolefins, by Standard Oil Co. of New Jersey; polybutenes (Vistanex), by Standard Oil Co. of New Jersey; polyphenylene ethylene, by U. S. Rubber Co.; polyvinyl alcohols, by du Pont; polyvinyl acetate chloride, by Carbide & Carbon Chemicals; polyvinylidene chloride, Dow; polyvinyl alcohol with formaldehyde, Monsanto Chemical Co.; polyvinylalcohol with butyraldehyde, Monsanto, Carbide & Carbon and du Pont; plasticized polyacrylic esters and mixed alkyd condensation products, Rohm & Haas Co. (Cramer, I. & E. C., Feb., 1942). Butyl rubber, not yet in commercial production, promises to be much less expensive than either Buna S or Buna N since in copolymerizing olefins with small amounts of diolefins to give just the proper degree of unsaturation for vulcanization but no more it involves a process more simple and more direct than the others and the raw materials are more readily available and less expensive.

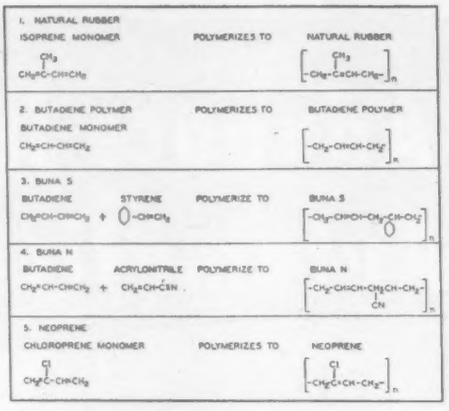


Fig. 2—Chemical sources of synthetic rubber

Neoprenes constituted about 52 per cent of our production of synthetic rubber in 1941 when it totaled less than 12,000 tons, according to Bridgewater. The balance was divided between butadiene types, 35 per cent, and polysulfides, 13 per cent. He estimates production in recent years as follows:

Year—	Neoprene types	Butadiene types	Polysulfide types
1939	1,750	None	500
1940	2,500	80	700
1941	6,300	4,000	1,400

Such progress in view of our over-all demand for rubber was negligible. The greatest steps to improve this condition and to relieve our dependence on imports, prior to the 400,000-ton program recently announced, were taken last year. A year and a half ago Congress authorized a study of our synthetic rubber industry. On the basis of this investigation the advisory committee to the Council of National Defense recommended that synthetic production should be expanded to 100,000 tons annually. In May 1941 Jesse Jones announced plans to build four synthetic plants each with a capacity of 10,000 tons per year of Buna S type rubber. These government-owned plants were to be operated under contract with the Rubber Reserve Co., an RFC subsidiary, by the four major rubber companies: Goodrich, Goodyear and Firestone at Akron and U. S. Rubber at Naugatauck, Conn. Private companies also took a considerable step forward independently. It was reported in October that the synthetic rubber capacity of private industry, either installed or under construction, had reached 35,000 tons per year.

Expansion of Plants

Included among the steps that were taken were:

Standard Oil Co. of New Jersey, which completed its first Buna rubber plant at Baton Rouge in April, undertook to expand its production to a rate of 15,000 tons annually, including 5,000 tons of Butyl rubber. This plant, costing from $12,000,000 to $15,000,000, is expected to be in operation late this year.

Hycar Chemical Co., owned 50 per cent each by Phillips Petroleum Co. and B. F. Goodrich Co., has trebled the capacity of its original plant at Akron and a second plant building for the Defense Plant Corp. at Louisville, Ky., is being tripled in size. Phillips also has plans in the preliminary stages for the construction of a butadiene plant to serve another synthetic rubber plant.

Shell Oil Co., Inc., recently began shipping butadiene from Houston where it completed a plant with a production of 5,000 tons per year. The butadiene is shipped to rubber companies for final processing.

Other plants for the production of butadiene were reported under construction by the Texas Co., Humble Oil & Refining Co., Carbide & Carbon

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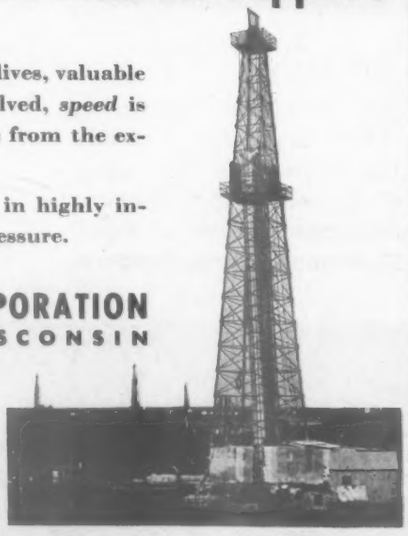
DuGas is particularly effective on fires in highly inflammable liquids, and on gases under pressure.

* Names on request.



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Chemicals, Monsanto Chemical Co. and others. The du Pont plant at Deepwater, Del., is being increased in size and a new plant at Louisville, Ky., which will increase the company's capacity to 19,000 tons of Neoprene a year is being erected. Dow Chemical Co. raised the capacity for producing Thiokol at Midland, Mich., to 1,750 tons annually last May and immediately thereafter began another 50 per cent expansion. B. F. Goodrich Co. is quadrupling the production of Keroseal (polyvinyl chloride) at Niagara Falls and Louisville. In addition to these steps, substantial changes are being made in natural gasoline plants throughout the country to increase the recovery of butane.

A summary of the immediate outlook indicates that total production at the end of 1942 will have reached the impressive but still inadequate total of 95,625 tons. The expansion to 400,000 tons projected in the recently announced RFC plan is not expected to be attained until some time late in 1943 and possibly 1944. An estimate of our total productive capacity on an annual basis at the end of this year follows:

	Long tons	
Private companies:		
Butadiene types	10,800	
Neoprene	19,200	
Polyvinyl chloride*	18,000	
Thiokol	2,625	
Butyl	5,000	
Total		55,625
Government owned:		
Butadiene types	40,000	40,000
Grand total		95,625

*Including plasticizer.

The above table emphasizes the dominant role of butadiene types in the present expansion program. Under normal circumstances the butadiene will be shipped from petroleum refineries to the processing plants in a liquid state under pressures of 20 to 40 per sq. in. In the manufacture of the synthetic rubber latex, the butadiene is purified and then mixed with the copolymer, styrene or acrylonitrile, in varying proportions depending on the character of the desired product. The proportions may range, according to the patents, from 60 to 80 per cent (normally it is about 75 per cent) of the butadiene to from 20 to 40 per cent of the copolymer.

Sources of Styrene

Styrene used in the Buna S type may be made by the dehydrogenation of ethyl benzene obtained from ethyl chloride, may be separated from cracked gases or may be recovered from light oil from the manufacture of carburetted water gas. Acrylonitrile can be obtained by dehydration of ethylene cyanohydrin or by the catalytic addition of hydrogen cyanide to acetylene.

After mixing the butadiene and the styrene or acrylonitrile are emulsified in water with the aid of soap or other emulsifying agent. Very small quantities of polymerization catalysts and modifying agents are added. Catalysts include hydrogen peroxide, sodium perborate, ammonium persulfate, etc. Modifying agents, which direct the course and degree of polymerization, include tetrachloride, trichloroproprionitrile, sodium cyanide, hexachlorethane, etc. The mixture is maintained at a temperature af approximately 50° C. for a period of approximately 12 hours until polymerization is completed.

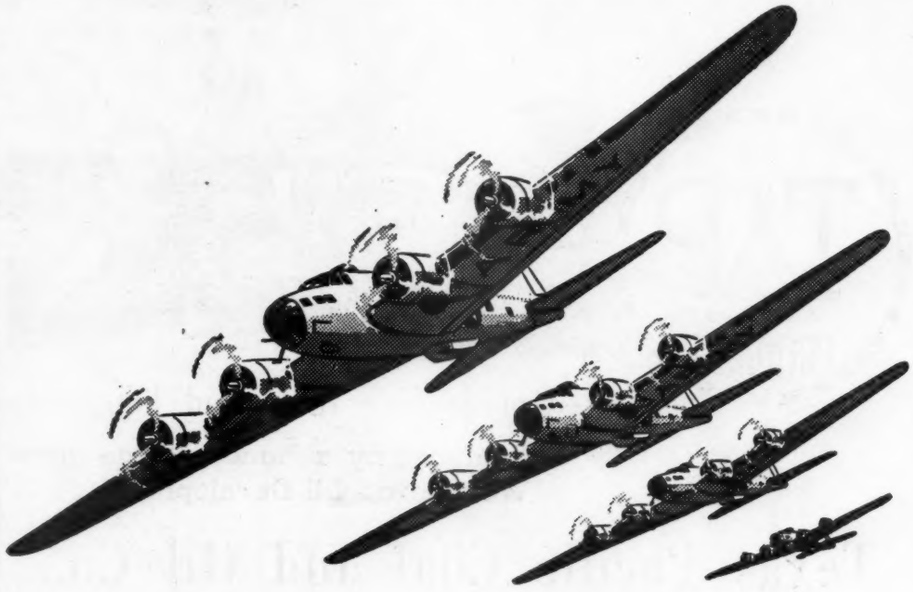
In order to prevent further polymerization a stabilizer or inhibitor, such as phenyl-beta-napthylamine, is added. The resultant latex, coagulated with acetic acid, washed and dried, is similar to latex produced from natural rubber. Vulcanization is carried out with sulfur together with zinc oxide and organic accelerators. The liquid from the polymerizing units used in the Hycar method contains about 2½ lb. of synthetic rubber.

The similarity to natural rubber latex does not extend to the processing stage. Street and Ebert (Rubber Chem. and Tech., January 1941) point out: "The statement often appears that synthetic rubbers process just like rubber on rubber machinery. On the contrary each material is different from every other. In large scale production, either production would be slowed down appreciably or certain equipment modifications would be required. In addition factory personnel, accustomed to running rubber stocks, would need appreciable experience with synthetic rubbers to make them run with as little technical supervision as is now necessary."

The chemistry of synthetic rubber has pursued an interesting course. In 1826 Michael Faraday found that natural rubber is a hydrocarbon with an empirical formula of C_5H_8. In 1860 Williams recognized rubber as a hydrocarbon made up of isoprene molecules. Bouchardat polymerized isoprene and obtained a rubber-like substance and revealed the monomer-polymer relationship between isoprene and rubber in 1879. In 1884 Sir William Tilden earned the title of "father of synthetic rubber" when he obtained isoprene from turpentine by pyrolisis and produced the first synthetic rubber. Attempts to duplicate natural rubber in its chemical structure were followed till after the turn of the century when research entered a new phase, the utilization of more readily available diolefins than isoprene. For this reason today's so-called synthetic rubbers are not truly "synthetic" products.

Butadiene From Coal

During the World War Germany manufactured methyl rubber from dimethyl butadiene. This development ended with the war and the problem was not revived until 1927 when commercial production of butadiene by conversion of coal and limestone was proved feasible. This butadiene was polymerized with sodium. Subsequent discovery of the improvements possible by the inclusion of acrylonitrile (vinyl cyanide) and



Eclipse of the Rising Sun!

Challenged in two hemispheres, America faces a tremendous test. But the bombers that will blot out the Rising Sun and smash the Swastika are winging off our production lines. The high-octane fuels and special lubricants to keep 'em flying are pouring from our refineries.

The biggest industrial job in all history is being done *because America has the electric POWER for the job!*

The electric industry was *ready* when the crisis came. The business men who manage the nation's electric companies had built up power reserves *in advance.* They were ready, too, to meet new demands with new construction. They *added* enough power in 1941 to light *one-fourth of all the nation's homes.*

We're glad that the electric industry has been able to help make Uncle Sam so powerful. We'll stick to the job until the blood-red sun has set and a new day follows darkness!

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styrene (vinyl benzene) led to the development of today's Buna type rubbers.

At about the same time the polysulfides and neoprenes were developed. In 1925 Nieuwland found that monovinylacetylene could be produced from acetylene with a cuprous chloride catalyst and du Pont chemists discovered that monovinylacetylene could be reacted with hydrogen chloride to produce chloroprene, a product susceptible of polymerization into rubber. The result was Duprene, since renamed Neoprene. Also about this time Patrick, seeking an antifreeze, mixed ethylene dichloride and sodium polysulfide and got a type of synthetic rubber now known as Thiokol and produced by Dow Chemical Co.

The greatest handicap in the growth of the synthetic rubber industry has been economics. Present costs of producing synthetic rubber are high due principally to the fact that production heretofore has been limited to a small scale basis and it has not been able to compete with natural rubber in price. Comparable prices and equivalent prices, those at which synthetic rubber would have to sell to be competitive with natural rubber, were listed by Cramer as follows:

	Aug. 1941 price	Density	Equivalent price
Natural rubbers	$0.23	0.92	$0.23
Neoprene Type GN	0.65	1.24	0.17
Buna S	0.60	0.96	0.22
Perbunan	0.70	0.96	0.22
Thiokol F	0.45	1.38	0.15
Vistanex	0.45	0.90	0.24
Kerosseal*	†0.60	1.33	0.16
Hycar OR	0.70	1.00	0.21

*30 per cent plasticized. †Estimated.

At the same time Cramer stated, "It has been reliably estimated, however, that on a large tonnage basis, butadiene could be produced for 10 to 15 cents and the finished polymers for 20 to 25 cents per pound." The Lamp (October 1941), official publication of the Standard Oil Co. of New Jersey, stated that "The basic raw materials of these synthetic rubbers are petroleum and natural gas which are worth less than 1 cent a pound in the crude form. As a far distant goal we might look toward a finished synthetic rubber at a price under 10 cents a pound." Synthetic rubber is entering the "large tonnage basis" as estimated by Frank H. Carman, staff expert, synthetic rubber branch, chemical and allied products branch, WPB, that the four 10,000-ton plants will require 35,000 tons of butadiene and 13,000 tons of styrene indicate.

In addition to the production costs, there are plant construction costs. Bridgewater (I. & E. C. 33, 1344. 1941) estimates the total cost of the four 10,000-ton plants for which the Government has let contracts at $11,000,000 and the cost of butadiene and styrene plants capable of meeting this demand at $25,000,000. This is a total of $36,000,000 or $900 per ton. On this basis an expenditure of $540,000,000 would be required to meet what might be described as average normal requirements, 600,000 tons per year. This is exclusive of costs for equipment to produce ammonium compounds for catalysts, animal and vegetable oils used as emulsifying agents and alcohols for stabilizers.

More recently (March 11, 1942) W. S. Parish, president, Standard Oil Co. of New Jersey, stated "Synthetic rubber of the Buna type has always cost at least twice as much as the natural product. Even in very large quantities this synthetic rubber would cost about 30 cents a pound against a normal price for natural rubber of less than 15 cents a pound. For large scale operations, including the raw materials needed, the investment required to produce Buna rubber is $1,000 per ton of yearly capacity—perhaps, $700,000,000 to $800,000,000 for the entire needs of the country, military and civilian. . . .

"Only the lack of natural rubber can justify this investment. . . . "In the interval since Pearl Harbor we have undertaken to produce for our government and the Canadian government a total of over 200,000 short tons annually of special synthetic rubber and raw materials for Buna rubber. This operation should be in full swing by the middle of 1943. . . .

"There are no patent questions involved. Patent agreements were arranged and signed with government approval last December covering all questions bearing on Buna rubber. Basic Buna patents have been allowed 1 per cent of the cost of the rubber. On this basis the royalty would amount to about 2½ cents on a $15 synthetic rubber tire."

Another factor to be considered in the economics is the variations which have taken place in the price of natural rubber. It reached a high of $3 per pound in 1910 and a low of 3 cents per pound in 1932 and 1933. When it rose from 16 cents a pound in 1920 to $1.23 a pound in 1925 it provided the stimulus which aided considerably in the development of synthetic substitutes. From the low of 3 cents a pound in the worst depression years it rose to 27 cents in 1937 but fell 11 cents in 1938. Its present price of about 22 cents a pound is, in effect, established by an agreement among the producing countries controlling the volume of supplies.

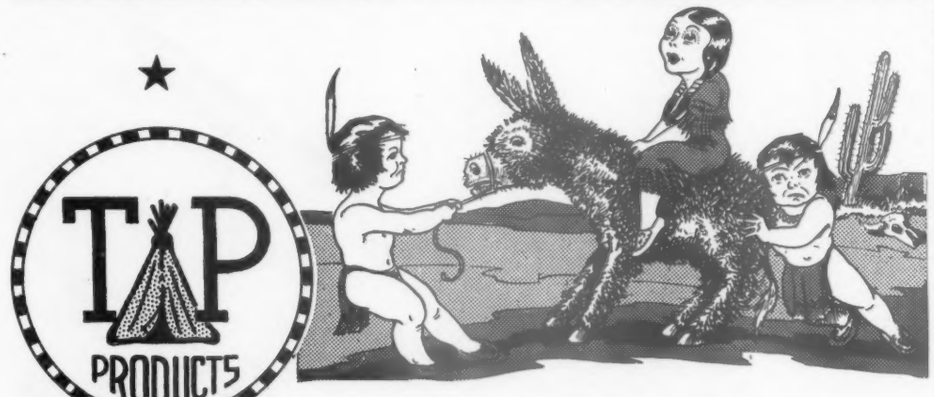
Whether or not synthetic rubber becomes a price competitor of natural rubber, the peculiar properties of the various types insure them a market which will grow as these properties are further developed and exploited.

●

Fractionating Tower at Montana Plant Finished

HAVRE, Mont.—A new fractionating tower installed at Hill Country Refinery's plant here will be ready for service around April 1. The plant is a 500-bbl. topping unit.

Myron Gilbert is superintendent and Roy Welter is assistant. The refinery is owned by A. Beardslee, Shelby, Mont.



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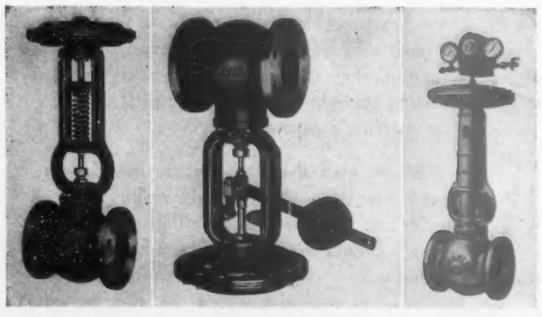

No. 14 No. 16 No. 401

No. 14—Davis Spring-Loaded Regulator for balanced, smooth-action control on steam, air, gas, water and oil lines. Reduced pressures from 0 to 300 lbs.

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Catalytic Desulfurization by Use of the Gray Process

By A. M. MARTIN and L. CARLSON
Indian Refining Co. Gray Processes Corp.

SULFUR, usually in a combined form, is an impurity found in practically all crude oils.

Since the very early days of petroleum processing, refiners have had to treat their products at some point in the course of manufacture to effect a change in, or removal of sulfur bodies.

The principal objections in the past to the presence of sulfur and sulfur compounds in gasoline were the factor of possible corrosiveness and the factor of odor; however, more recently and of more importance practically and economically, is the recognized effect of certain sulfur compounds in depressing tetraethyl lead susceptibility of gasoline fractions. The presence of sulfur compounds, therefore, proved to be very costly to many refiners because of the excessive quantity of tetraethyl lead required to offset their effect.

As octane levels steadily climbed, and quantities of tetraethyl lead required to meet the higher levels increased, refiners became more and more conscious of lead susceptibility and the inhibiting action of sulfur compounds on the responsiveness of a gasoline to the addition of tetraethyl lead.

Chemical Methods of Desulfurization

Various chemical methods have been found effective for removing sulfur compounds, but they are often costly as regards chemical consumption and other operating factors. Sulfuric acid refining, which has long been used and is still used to reduce total sulfur to meet requirements of sulfur specification and stability, improves lead susceptibility to a limited extent

(Continued on Page 142)

TABLE 1—EFFECT OF CATALYSTS ON STRAIGHTRUN GASOLINES

Catalyst	Fuller's Earth A		Fuller's Earth B		Fuller's Earth C		Fuller's Earth D		Bauxite A		Bauxite B	
Temperature	703		700		690		700		700		701	
	H_2S free charge	H_2S free product	H_2S free charge	H_2S free product	H_2S free charge	H_2S free product	H_2S free charge	H_2S free product	H_2S free charge	H_2S free product	H_2S free charge	H_2S free product
Gravity, °A.P.I.	59.1	59.0	59.1	59.1	59.1	59.2	59.1	58.9	59.1	58.9	59.1	58.8
Color, Saybolt	+30	+18	+30	+23	+30	+21	+30	+26	+30	+20	+30	+21
Sulfur, lamp, per cent	0.167	0.0200	0.167	0.0160	0.167	0.0170	0.167	0.0140	0.167	0.016	0.167	0.011
Sulfur, mercaptan, per cent	0.076	0.0014	0.077	0.0008	0.077	0.0022	0.076	0.0003	0.076	0.000	0.076	0.000
Sulfur, nonmercaptan, per cent (by diff.)	0.091	0.0186	0.090	0.0152	0.090	0.0148	0.091	0.0137	0.091	0.016	0.091	0.011
Gum, cu. dish	5	6	6	3	5	4	5	6	5	6	5	4
Gum, A.S.T.M.	1	Trace	1	1	1	4	1	1	1	1	1	1
Induction period, Voorhees and Elsinger, minutes	1,200+	1,200+	1,200+	1,200+	1,200+	1,200+	1,200+	1,200+	1,200+	1,200+	1,200+	1,200+
Octane No. A.S.T.M.:												
Clear	58.4	60.7	58.4	60.3	58.4	60.4	58.4	60.6	58.4	60.4	58.4	59.0
+0.5 cc. TEL	62.2	67.2	62.2	67.6	62.2	67.3	62.2	67.0	62.2	67.1	62.2	65.7
+1.0 cc. TEL	65.3	72.2	65.3	72.7	65.3	73.0	65.3	72.7	65.3	73.3	65.3	71.2
+2.0 cc. TEL	69.6	77.4	69.6	78.7	69.6	77.6	69.6	78.0	69.6	78.6	69.6	76.9
+3.0 cc. TEL	72.6	81.1	72.6	81.8	72.6	80.6	72.6	80.9	72.6	81.0	72.6	79.9
Lead susc., H.R.&G.	1.12	1.91	1.12	2.03	1.12	1.85	1.12	1.90	1.12	1.90	1.12	1.88
Reid vapor pressure, lb.	7.5	7.1	7.5	7.2	7.5	6.8	7.5	6.4	7.5	6.9	7.5	6.0
A.S.T.M. distillation:												
I.B.P. °F.	107	108	107	110	107	106	107	112	107	109	107	110
10 per cent	170	171	170	170	170	168	170	172	170	171	170	172
20 per cent	....	....	....	....	....	....	....	....	....	....	....	....
50 per cent	258	259	258	258	258	258	258	257	258	259	258	258
90 per cent	344	345	344	344	344	343	344	348	344	344	344	343
EP	388	380	388	388	388	388	388	394	388	397	388	386
Rec., per cent	97.0	97.0	97.0	97.0	97.0	97.5	97.0	97.0	97.0	97.5	97.0	98.0
Res., per cent	1.0	1.0	0.7	0.8	0.7	0.7	1.0	0.6	1.0	0.7	1.0	0.8
Loss, per cent	2.0	2.0	2.3	2.1	2.3	1.8	2.0	2.4	2.0	1.8	2.0	1.2
Total sulfur reduction, per cent	....	88	....	90	....	90	....	92	....	90	....	93
Mercaptan sulfur reduction, per cent	....	98.3	....	99	....	97	....	99.6	....	100	....	100
Nonmercaptan sulfur reduction, per cent	....	80	....	83	....	84	....	85	....	82	....	88
Lead susceptibility increase	....	0.79	....	0.91	....	0.73	....	0.78	....	0.78	....	0.76
Clear octane increase	....	2.3	....	1.9	....	2.0	....	2.2	....	2.0	....	0.6

TABLE 2—TYPICAL GRAY DESULFURIZATION RESULTS OF ILLINOIS STRAIGHTRUN GASOLINES—INDIAN REFINING CO., LAWRENCEVILLE, ILL.

	Light straightrun gasoline		Heavy straightrun gasoline		Full-range straightrun gasoline	
	Charge	Desulfurized product (*)	Charge	Desulfurized product (*)	Charge	Desulfurized product
Clay life: bbls. gasoline/ton clay	...	...	...	...	...	...
R.V.P., lb.	7.2	7.3	1.4	1.1	4.0	3.8
Distillation:						
I.B.P., °F.	102	100	155	147	132	131
10	146	146	222	214	188	187
20	166	166	245	241	210	210
50	212	210	295	292	263	261
90	302	306	364	367	349	348
E.P.	368	368	401	402	396	395
Per cent recovery	98.0	98.0	99.0	99.0	99.0	99.0
A.S.T.M. gum	0	1	1	1		
C.D. gum	4	0	10	3		
Doctor test	...	Neg.		Neg.		
Corr. Cu. Strip at 122° F.	...	Neg.		Neg.		
Butyl mercaptan test—minutes		+30		+30		
Per cent total sulfur (lamp)	.015	.006	.040	.006	.038	.006
Per cent mercaptan sulfur	.004	0	.008		.007	
Per cent nonmercaptan sulfur	.011	.006	.032	.006	.021	.006
Octane number—A.S.T.M.:						
Clear	58.5	60.4	43.2	47.9	47.8	50.3
+0.5 cc. TEL					54.1	56.8
+1.0	67.5	70.6	51.3	55.9	58.1	62.4
+2.0	73.0	76.9	57.4	63.1	63.7	70.0
+3.0	76.1	80.0	61.3	67.5	68.0	74.0
+4.0	78.8	81.5	64.9	70.0	70.9	76.9
H.R.&G. susceptibility	1.63	1.94	1.40	1.75	1.57	2.10
Clear octane increase	...	1.9	...	4.7	...	2.5
Octane increase at 3 cc. level	...	3.9	...	6.2	...	6.0
Per cent total sulfur reduction	...	60.0%	...	85.0%	...	84.0%
Per cent mercaptan sulfur reduction	...	100.0	...	100.0	...	100.0
Per cent nonmercaptan sulfur reduction	...	45.0	...	81.0	...	71.0

*All samples composited over entire operation period. Total clay life for these two runs was 5,324 bbl. of light and heavy straightrun gasoline per ton clay.

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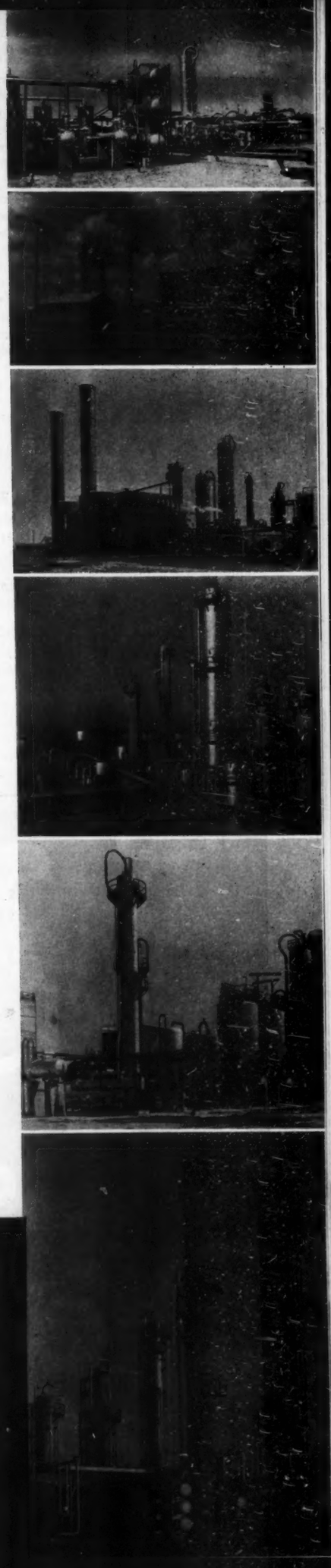
More power, then, to American refiners in their restless, ceaseless, successful search for better gasolines and better lubricants for the machinery of industry and national defense.

We are grateful for the experience and the facilities with which to co-operate.



ENGINEERING & CONSTRUCTION DIVISION
OF
FRICK-REID *Supply Corporation*
Tulsa, Oklahoma

through the removal of mercaptan sulfur as well as other types of sulfur compounds. In some cases relatively large volumes of sulfuric acid are required to effect substantial desulfurization, and relatively high losses are entailed by excessive solution and polymerization of the gasoline hydrocarbons.

The use of sulfuric acid also carries with it problems of acid recovery and sludge disposal, and it is desirable to avoid these conditions wherever possible.

The conventional "doctor sweetening" method converts the offensive mercaptans to less odoriferous sulfur compounds which, nevertheless, remain in the gasoline and which are, as a matter of fact, objectionable from the standpoint of their effect on the tetraethyl lead response of the gasoline.

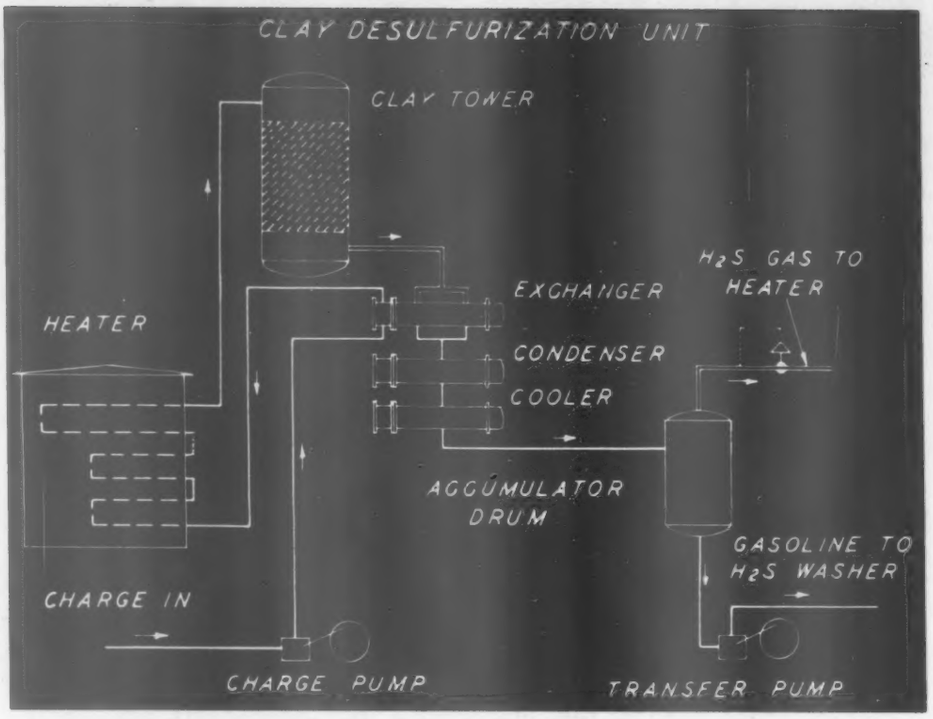
Other methods are in large scale use in gasoline refining which actually remove the sulfur compounds but these seem to be applicable largely to the removal of the mercaptans without in many instances effecting any appreciable removal of other sulfur compounds.

Catalytic Methods for Sulfur Removal

In keeping with the trend of modern refining practice to employ contact catalysis for an increasing number of purposes, the industry is examining catalytic methods of eliminating the deleterious mercaptan and nonmercaptan sulfur compounds from petroleum fractions.

Gray Catalytic Desulfurization

The Gray catalytic desulfurization process, now commercially used for the elimination of both mercaptan and nonmercaptan sulfur compounds from lighter petroleum fractions, meets the need for a catalytic process utilizing a low-cost catalyst and enabling the employment of a highly selective procedure to minimize product losses through undesirable side effects.



To accomplish the desulfurization, gasoline vapors are passed through a bed of the catalyst at an elevated temperature, the temperature dependent on the type of charge stock and the degree of effect desired. The pressure of operation, while usually of a low range, is sufficient to secure the desired flow of vapors through the process and auxiliary equipment.

The catalyst used is of the solid adsorbent type, such as fuller's earth and the like, which is cheap and readily available from many widely spaced deposits in the United States, and therefore conveniently accessible to all refining centers in this country. It has been found that a wide selection of effective clays can be used and several plants operating the Gray catalytic desulfurization process are each using different fuller's earth, the choice of the clay being made after consideration of the various operating and economic factors.

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Because of the varied nature of the charge stock and operations at the several plants, a comparison of the effectiveness of a wide variety of clays on a given charge stock has been made in the laboratory. The results of this comparison are given in Table 1.

An example of a commercial operation is afforded by the installation of this process in the plant of the Indian Refining Co. at Lawrenceville, Ill. A flow diagram pertaining to this installation is shown.

In the application of the process to straightrun gasoline (referring to the flow diagram), the desired fraction is heated to a temperature of in the order of 700° F. in a furnace of simple design. The heated vapors pass through a bed of solid adsorbent catalyst, at a flow rate dependent upon the character of the feed and nature of the sulfur compounds, wherein the conversion of mercaptan and nonmercaptan sulfur compounds takes place. The vapors leaving the catalyst chamber pass in heat exchange with the incoming gasoline and go then to a condenser and separator. A large part of the sulfur present in the original mercaptan and nonmercaptan sulfur compounds is converted to hydrogen sulfide, which is partially removed in the separator; the remainder in the gasoline is then removed by means of either a caustic wash or simple stabilization. One of the important economic factors realized as a result of application of the Gray process to straightrun gasoline is that, other than removal of hydrogen sulfide, no further treatment of the gasoline is required.

Some Applications of the Process

It is of interest that the process can be applied to gasoline of low sulfur content, as well as high sulfur content, to realize considerable economy. Table 2 sets forth some typical results obtained on the desulfurization of moderately low sulfur straightrun gasolines from Illinois crude at the Lawrenceville unit. The increase in clear octane number upon desulfurization ranged from 1.9 to 4.7 units, and the increase in octane number after the addition of 3 cc. of tetraethyl lead ranged from 3.9 to 6.2 units. The total sulfur reduction, expressed in percentage of the original total sulfur, ranged from 60 to 85 per cent. The extent of this reduction can be varied by slight changes in operating conditions. The mercaptan sulfur was entirely eliminated and the nonmercaptan sulfur has in all cases been reduced to a value of 0.006 per cent. The usual sweetening step heretofore applied has been eliminated. Since the Lawrenceville installation processes low sulfur stocks, sulfur reduction to meet a specification is not an object. The operation is primarily conducted in order that the maximum lead susceptibility inherent in the hydrocarbon product may be realized. The reduction in lead requirements at Lawrenceville is substantial; however, the savings effected increase with increased sulfur content.

An example of the marked changes in lead susceptibility and the substantial savings that can be realized on the desulfurization of a higher sulfur straightrun gasoline will be afforded by reference to Table 1.

When applied to straightrun fractions the improvement in lead susceptibility to be expected by desulfurization is principally a function of the lead susceptibility of the starting material. It has been found that most straightrun fractions have a lead susceptibility* of 1.8 to 2.0 on an essentially sulfur-free basis. High sulfur gasolines usually have a lead susceptibility very much lower than 1.8 to 2.0 and for this reason are definitely amenable to desulfurization treatment for the purpose of increasing the lead susceptibility. Some low sulfur gasolines have an inherent lead susceptibility of in the order of 1.8 to 2.0, and such gasolines will ordinarily not be improved by desulfurization as regards lead susceptibility, *but*, there are also a number of low sulfur gasolines which are definitely poor in lead susceptibility and can be improved in this respect by the Gray catalytic desulfurization process. The applicability of the process, from the standpoint of tetraethyl lead saving, is therefore best measured by the lead susceptibility of the stock in question rather than by the sulfur content. In addition to processing ordinary motor fuel gasoline, the process also has application to those straightrun aviation base stocks which have good octane characteristics but which have less than maximum lead susceptibility. In this connection the value of desulfurization is determined primarily from the standpoint of blending characteristics; more particularly, by the relative quantities, before and after desulfurization, of straightrun base stock which will be usable in the total aviation blend to make octane specifications with the maximum allowable amount of tetraethyl lead.

*By the Hebl, Rendel and Garton scale (Ind. & Eng. Chem., July 1939) slightly modified, plotting the best straight line for A.S.T.M. octane number with 0, 1, 2 and 3 cc. of tetraethyl lead).

TABLE 3—CLAY DESULFURIZATION UNIT OPERATIONS UTILITY REQUIREMENTS

	Requirements per bbl. charge
Electric power*	.206 kw.-hr.
Water	183.6 gal.
Steam†	.603 lb.

*Charge and transfer pumps are electric-motor driven. †Steam at 158 lb. per sq. in. gage is used only for steaming out the clay tower when clay is changed.

Operating Cost

Due to the fact that automatic devices are in-

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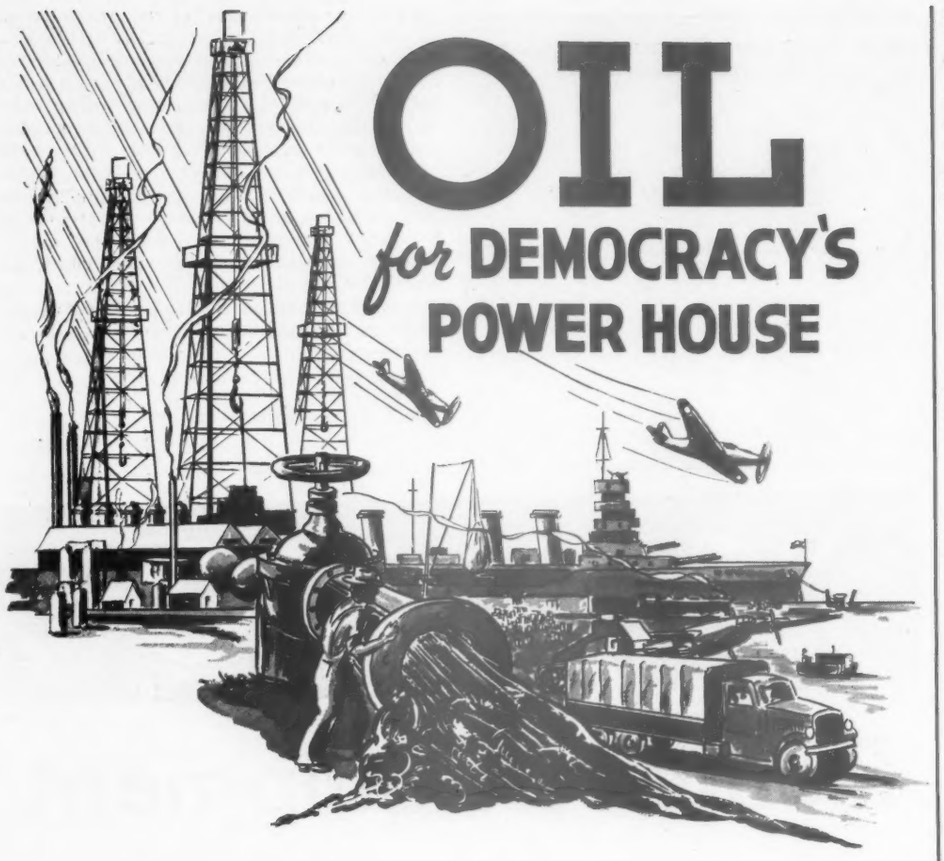

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stalled for control of temperature and charge rate, only a very moderate amount of operating attention is required.

Operating cost items for practice of the process are comprised of catalyst, fuel, water, steam or electric power, caustic soda, and that proportion of operating labor cost which is chargeable to the operation. (Table 3 gives typical utility requirements for the type of operation under consideration). Loss of product through the unit is too small to be accurately measured, but an allowance of one-half of 1 per cent is considered to be ample. Wherever light products are handled the loss will be no more than is normally obtained on good rerunning practice.

●

Union Oil to Build Isopentane Plant To Make 100-Octane Gasoline

Union Oil Co. is putting the finishing touches on a new unit at its Wilmington refinery which, when in operation, will produce isopentane for use as a blending agent in the production of 100-octane aviation gasoline. In addition, the company also has under construction a gas reversion plant, which embodies many important advances in refining, and this unit should be in operation shortly. The gas reversion plant will replace depreciated cracking units and will produce an increased yield of high quality gasoline. This unit will handle refinery still gases and will also furnish feed stocks for the alkylation plant which will result in increased production of 100-octane aviation gasoline. At the Maltha refinery near Bakersfield the company has replaced its old asphalt and road oil stills with modern and more efficient equipment. In addition, a gasoline stabilizing unit has also been installed at the Maltha refinery. During the past year, a new coking unit, designed to process low gravity high sulfur crude oils, was placed in operation at the Oleum refinery in the San Francisco Bay region. This unit produces gas oils and distillates from the heavy crude oil along with coke. The coke is sold to Pacific Gas & Electric Co. which uses it in the production and generation of electricity. Late in 1941, Union Oil Co. completed a new plant designed to produce waxes of considerably higher melting point than the usual paraffin waxes. These waxes are used in the manufacture of liquid-proof paper containers and food wrappers and may be substituted for waxes which were formerly imported. A hydroformer plant, or catalytic unit, was also placed in operation and this unit converts unfinished gasolines and distillates into blending materials for the production of high-octane gasolines. To replace older facilities the company is at present constructing new units at Oleum refinery to produce asphalts and lubricating oils.

Gulf Honors 2,496 Employes With 10-40 Years of Service

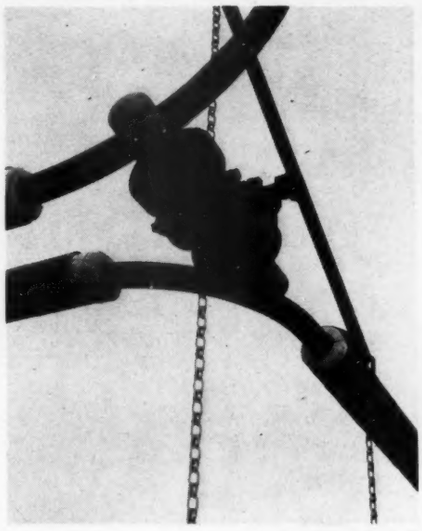
PITTSBURGH, Pa.—Emphasizing the need for efficient, trained labor to speed up war production, J. Frank Drake, president of the Gulf Oil Corp., has announced that 2,496 employes will be given service awards for 10 to 40 years of service with the organization.

The awards will be presented by April 10 to the employes in different offices of the company in 32 states by local officials. Two of the employes have completed 40 years of service and 16 have completed 35 years.

"In past years," said Mr. Drake, "service awards to our employes were presented at dinners or special gatherings at some 40 points throughout our territory. This year, because of the war, it has been decided that no formal affairs would be held. Instead individual presentations will be made by vice presidents, refinery superintendents, division managers and other ranking officials in the different areas."

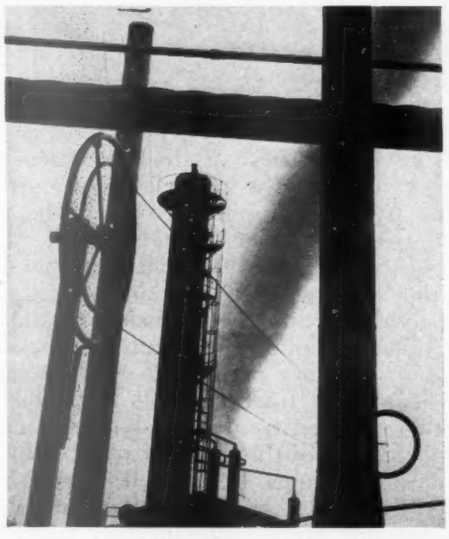
Refinery IDEAS ... that save $ $ $

Tangential Welds and Sweeping Bends Used on Cored Lines



Refinery service lines which must be heated by small steam pipes running through them can be economically connected without disrupting the steam flow by bending the two lines tangentially to a connecting pipe. The accompanying picture shows the method employed by one company. Here the connection is made through an arm-opening valve. The bull plugs or closed short sections of pipe serve as the connecting medium. Holes were burned through the walls of the oil lines and through the bull plugs at points where the lines touched and then the assembly was welded to make an oil-tight job.

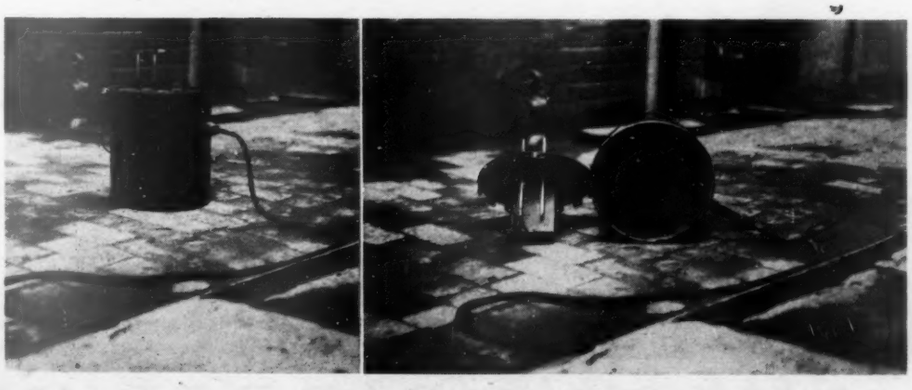
Remote Damper Control On Furnace Stack



Approximately 1,000 ft. away from the base of stack located in a refinery the company has erected an emergency damper control. By means of a simple grooved wheel and continuous cable the arms of the damper can be adjusted vertically or horizontally. The picture shows the arms in the normal operating position but in case of a fire the draft would be closed to avoid intensifying the heat. This would be safely carried out by revolving the wheel shown here and allowing the arms of the damper to reach a horizontal position. The equipment needed is well illustrated in the picture and, obviously, the assembly of the equipment involves some simple procedures in ordinary plant welding.

Portable Ladder Equipped With Rail

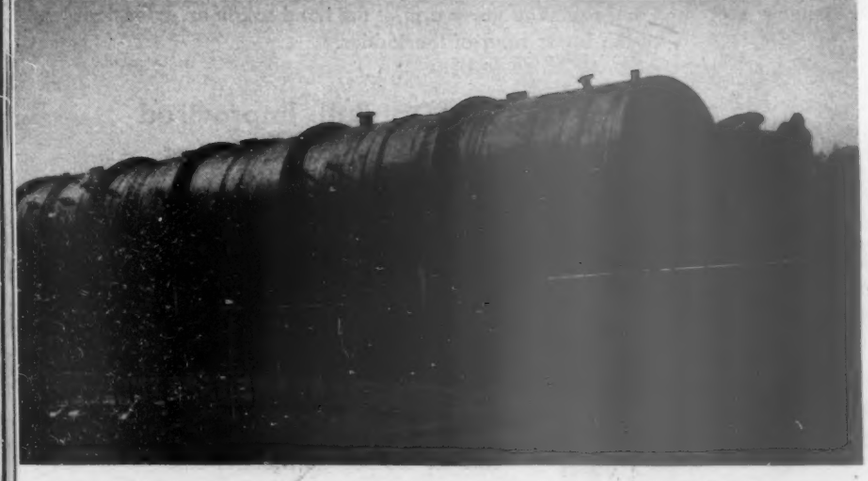
Refiners are sometimes obliged to locate centrifugal pumps of high capacity in concrete-lined pits near storage tanks and away from the general refinery pump house. This decentralization of pumping has operating advantages and disadvantages. Obviously, one of the disadvantages is in providing the same degree of convenience and safety to a remote pumping installation as to a centralized group of units. Here the operator has recognized the need to supply a portable and durable ladder for one of these pits. The construction of the ladder is almost self-evident and its feature is the welded hand rail. The lower arm of the hand rail is an extension of the lower rung of the ladder.



Wet-Dry Bulb Improvised To Test Air From Filters

This wet-dry bulb apparatus was made up to test the relative dryness of air from filters. The body is an old pail with a support for the bulb and a baffle welded in. It is shown with the top removed in one picture and assembled in the other. Dried air is used to displace wet air in tank cars before they are filled and to replace liquid in tanks as they are emptied. This practice is valuable when preparing cars for loading transformer oils.

"Batteries" of Pressure Vessels



"BATTERIES" of steel pressure vessels, like the batteries of our armed forces, are playing an important role in the war effort. For, without modern equipment like that illustrated on these pages, it would be impossible for the nation's refineries to sustain today's vital production of high octane fuels, lubricants, and the numerous other essential petroleum products.

Production capacity of welded steel pressure vessels and refinery towers of all types has of course been increased tremendously, but the design and fabrication of this class of work is by no means new to our shops. Plant facilities for handling difficult welding and fabrication, as well as radiographing and stress-relieving, are complete in every detail. All work must pass the strictest inspection during each step of fabrication, which assures the expected results when installed.

Units being fabricated for meeting specific oil industry requirements include: Bubble Towers—Fractionating Columns—Cracking Chambers—Polymerization Towers—Accumulators—Butane and Propane Tanks—Evaporators—Oil Stills—Reaction Chambers—Absorber Towers—Flash Towers—Reforming Towers—Reflux Towers—Stripping Towers—and pressure or vacuum vessels for all purposes.

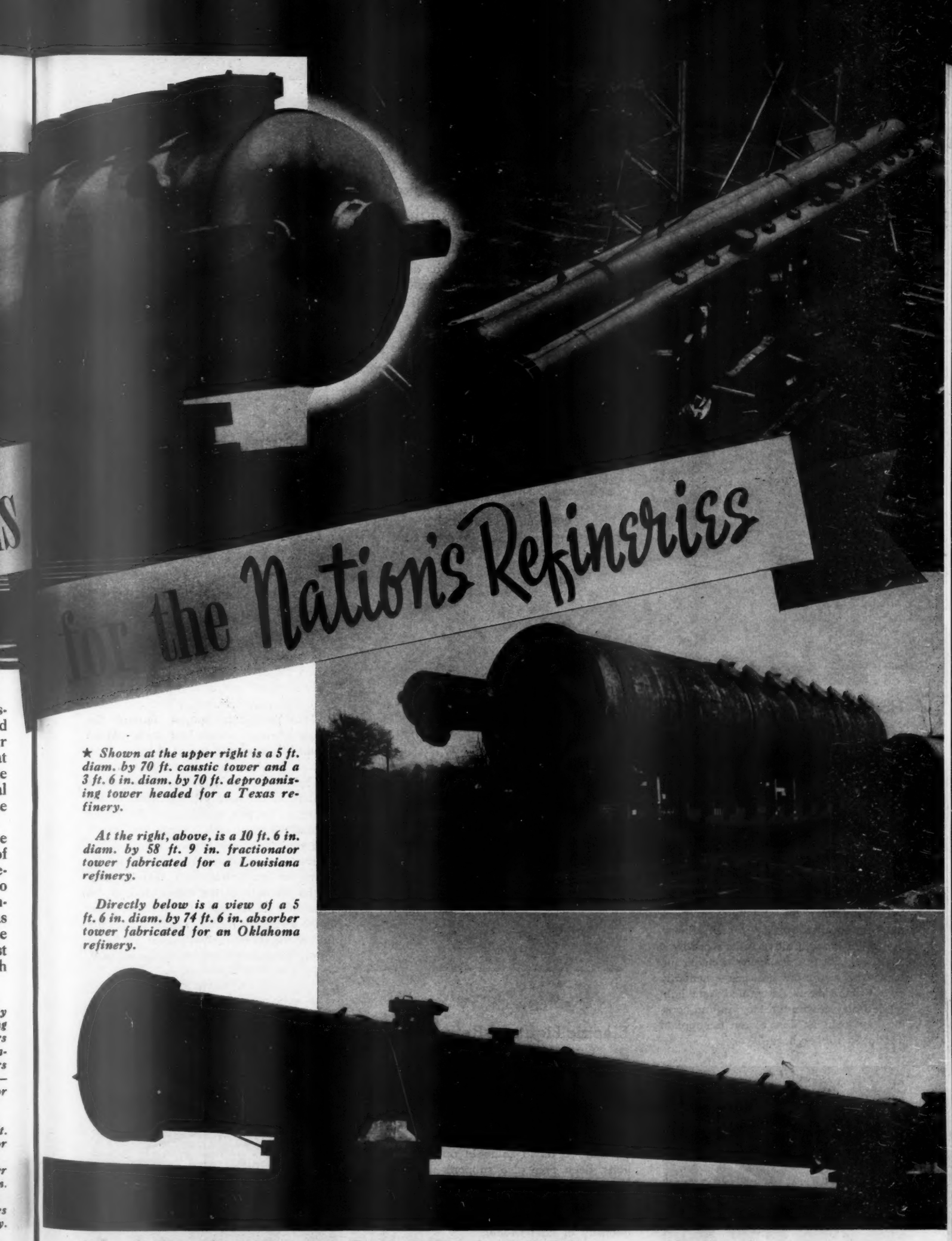
★ *The large view at the top shows a 6 ft. diam. by 80 ft. stabilizer tower which was x-rayed and stress-relieved for a New Jersey refinery.*

At the left, center, is a view of a debutanizer tower fabricated for a Texas refinery. It measures 5 ft. 6 in. in diam. by 86 ft. long.

The vacuum flash tower shown at the left measures 8 ft. 6 in. in diam. by 50 ft., built for a Kentucky refinery.

CHICAGO BRIDGE

BIRMINGHAM - CHICAGO - CLEVELAND - DETROIT - HAVANA - HOUSTON



for the Nation's Refineries

★ *Shown at the upper right is a 5 ft. diam. by 70 ft. caustic tower and a 3 ft. 6 in. diam. by 70 ft. depropanizing tower headed for a Texas refinery.*

At the right, above, is a 10 ft. 6 in. diam. by 58 ft. 9 in. fractionator tower fabricated for a Louisiana refinery.

Directly below is a view of a 5 ft. 6 in. diam. by 74 ft. 6 in. absorber tower fabricated for an Oklahoma refinery.

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Refinery IDEAS

. . . that save $ $ $

Hall Radiator Made From Pipe Taken From Junk Pile →

An attractive and unusually rugged and efficient steam heating unit was assembled by a refinery welder from pipe discarded as junk. The plan of assembly is shown here and essentially calls for two units of welded pipe tied together at opposite corners to provide a common inlet for the steam and common outlet for the condensate. The headers in each unit are short lengths of 4-in. pipe while the upright elements are cut from 2-in. pipe. The headers are connected with 2-in. pipe. The assembly rests upon floor plates which have been cut from ¼-in. iron and welded across the two units. Each floor plate contains the usual upright and horizontal sections and in addition, in this case, the flat bottom plate rests upon hardwood blocks to add to its mass and attractiveness.

Hose Support—Wrench Rack

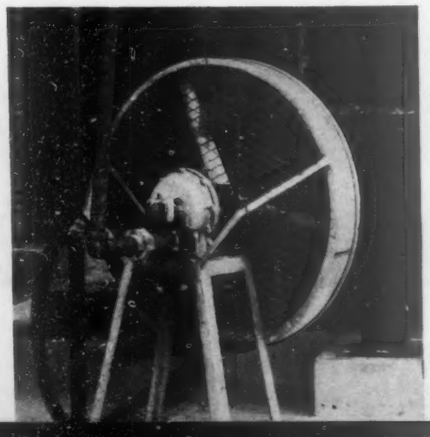
One end of a discarded oil drum serves a dual purpose in this refinery. It is nailed to a wall to serve as a hose rack and as storage for small wrenches and other tools. The tool supports are merely nails driven part way into boards cut to fit and placed in the drum end.

Wire Net Welded to Sturdy Frame Protects Operator

After having rigged a tractor with a hoist for general plant work, this refiner protected his driver against the cable snapping back in case of a break. The hoist itself was made unusually strong and the pull of the tractor engine through the winch allows a severe load to be placed on the cable should the need arise. This, in turn, might be great enough to break the cable and a backlash could be severe enough to cut or crush the head of the operator. In this installation, the frame around the wire mesh is made from angle iron and is heavy enough to allow the heavy wire mesh to be welded to the frame at each link and thereby add to the strength of the frame and to the resistance of the wire at any single point in the web. The frame extends across the full width of the driver's seat so he is amply protected from all angles of pull.

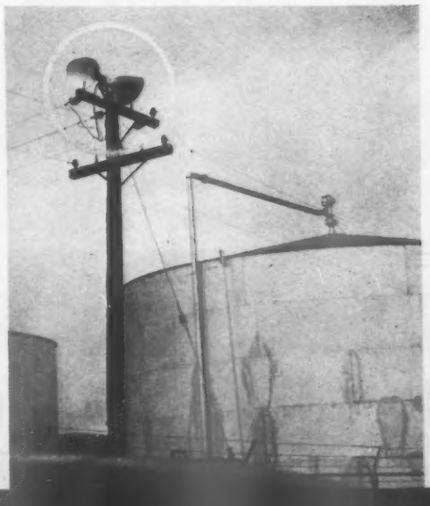
Steam-Driven Turbine Drives Cooling Fan

When a job on the still tubes or stack must be handled quickly in one refinery, the repair crew is aided in its work by a 36-in. exhaust fan driven by a steam turbine. The assembly consists essentially of a welded stand assembled from light angle iron, a steam turbine, fan, fan housing, and exhaust line. Steam is supplied through a rubber hose.

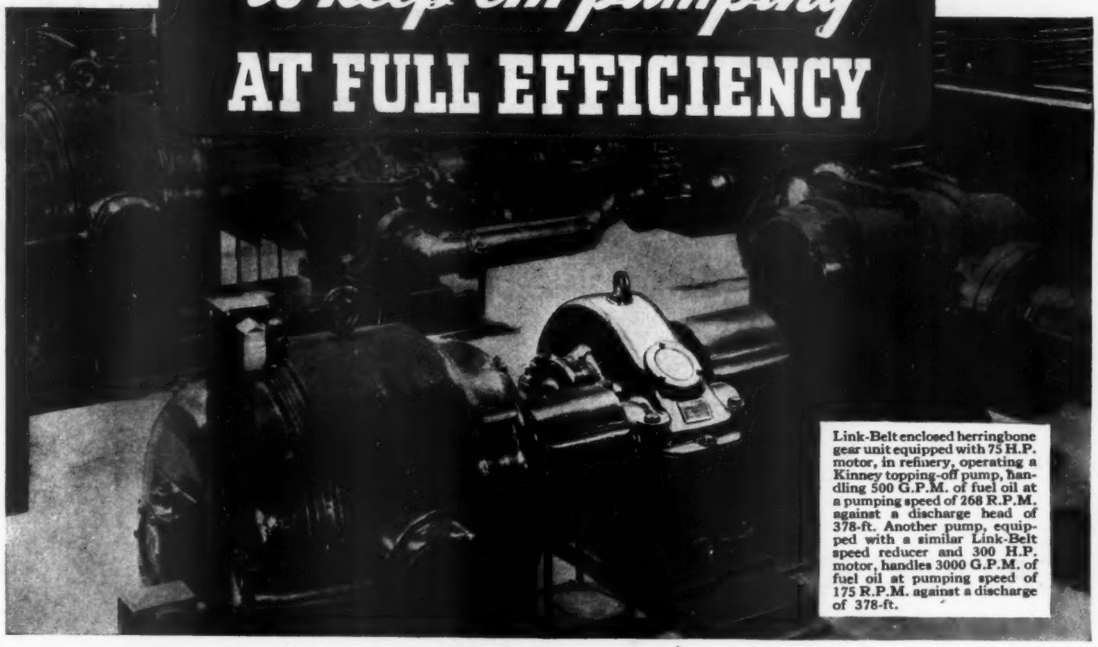


Electric Lights at Refineries →

Refineries now need lights along their plant fences to a greater degree than at any time in the past. One small plant has solved its fence-lighting problem very economically by erecting poles along the fence and mounting two ordinary floodlights at the top of each so as to shine in opposite directions. Each pole also supports the electric wires. A line of these poles can be erected over an indefinite length and at intervals determined by the strength of the lamps and intensity of light needed.



Correct SPEED *to keep 'em pumping* AT FULL EFFICIENCY

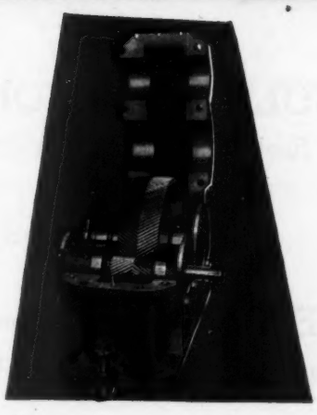


Link-Belt enclosed herringbone gear unit equipped with 75 H.P. motor, in refinery, operating a Kinney topping-off pump, handling 500 G.P.M. of fuel oil at a pumping speed of 268 R.P.M. against a discharge head of 378-ft. Another pump, equipped with a similar Link-Belt speed reducer and 300 H.P. motor, handles 3000 G.P.M. of fuel oil at pumping speed of 175 R.P.M. against a discharge of 378-ft.

● Link-Belt enclosed herringbone gear speed increasing and reduction units are outstanding in the field. Here are just a few of their many features:

Gears—continuous herringbone type—Sykes tooth form, using 20 degree pressure angle, 30 degree helical angle—involute teeth. Made of heat treated alloy steel forgings or electric alloy steel castings.

Housings—neat, sturdy, oil-tight, dust-proof—cast gray iron—of proper size to dissipate any heat generated within the thermal rating of unit.



Types—made in single, double and triple reductions up to 1000 H.P. Ratios 10:1 to 318:1.

Units are anti-friction bearing equipped throughout—with oversize bearings on the output to permit overhung loads. Leak-proof seals on high and low speed shaft projections keep grease in and dirt out. Complete data in 32-page Book No. 1519.

We also make Speed Reducers of the Worm Gear and Motorized Helical Gear types. Send for Catalogs Nos. 1515 and 1524.

LINK-BELT COMPANY

Philadelphia Dallas Houston Los Angeles Kansas City, Mo. New York Toronto Distributors in all fields 8807

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ALKYLATION—Processes for preparing synthetic aviation blending stocks of high quality and in high yield.

GAS-DEHYDROGENATION—Catalytic conversion of paraffin hydrocarbons to corresponding olefins, such as butane to butylene.

CATALYTIC ISOMERIZATION—Reconstruction of hydrocarbons to improve chemical and anti-knock characteristics.

CATALYTIC DESULFURIZATION—Treatment of aviation base stocks and motor fuels to obtain greatly increased tetraethyl lead susceptibility.

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GAS REVERSION—Thermal processing of gaseous hydrocarbons with light or heavy oils to produce high octane stocks with improved yields.

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SUPER FRACTIONATION—Complete processes including azeotropic distillation and selective extraction for separation of specific hydrocarbons or narrow-boiling fractions from complex mixtures, applicable in the preparation of selected conversion stocks and blending stocks.

For Further Information Write or Wire

PHILLIPS PETROLEUM COMPANY
BARTLESVILLE, OKLAHOMA
U. S. A.

Refineries Operating in United States

Explanation of Terms Used in Operating Survey

(Comp.)—Complete plant, gasoline, kerosene, gas oil, fuel oil, lubricating oils, paraffin, wax, and asphalt, usually includes cracking.
(S)—Gasoline, kerosene distillate, gas oil, and fuel oil.
(L)—Lubricating oils.
(A)—Asphalt.
(C)—Same products as skimming, except equipped for cracking.
(W)—Wax.

ALABAMA

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery	Type of cracking plant
Coastal Pet. Corp., Mobile	4,000	.....	S	
ARKANSAS				
Berry Asphalt Co., Waterloo	1,500	.....	S-L-A	
Lion Oil Ref. Co., El Dorado	19,000	2,000	S-C-L-A	Own
Macmillan Pet. Corp., Norphlet	4,000	.....	S-L-A	
Root Pet. Co., El Dorado	12,000	3,000	S-C	Own
Stephens Ref. Co., Inc., Stephens	1,000	.....	S	
Total	37,500	.....		
Estimated cracked gasoline capacity		5,000		
CALIFORNIA				
Caminol Co., Ltd., Santa Fe Springs	4,000	1,200	S-C	Donnelly
Caminol Co., Ltd., Hanford	3,500	700	S-C	Donnelly
Century Oil Co., Signal Hill	5,000	.....	S	
Comet Oil Co., Ltd., Long Beach	2,500	750	S-C	Comb.
Douglas Oil & Ref. Co., Gardena	12,000	4,000	S-C	Dubbs
Eagle Oil & Ref. Co., Santa Fe Springs	5,500	450	S-C	Dubbs
El Camino Ref. Co., Los Alamitos	3,000	.....	S	
Elm Oil Co., Long Beach	2,500	.....	S	
El Tejon Oil & Ref. Corp., Mountain View	3,500	425	S-C	Dubbs
Exeter Ref. Co., Long Beach	10,000	.....	S-A	
Field, O. C., Gasoline Corp., Casmalia	2,500	.....	S-A	
Five C Ref. Co., Santa Maria	2,500	.....	S-A	
Fletcher Oil Co., Inc., Wilmington	3,100	*2,000	S-C	Dubbs
General Pet. Corp. of Calif., Torrance	65,000	6,000	S-C	Lummus-Kellogg
General Pet. Corp. of Calif., Lebec	23,000	.....	S	
Gilmore Oil Co., Vernon	2,500	.....	S-A	
Golden Bear Oil Co., Oildale	2,500	.....	S-L-A	
Hancock Oil Co. of Calif., Long Beach	12,500	1,250	S-C	W. T. Hancock
Harbor Ref. Co., Inc., Long Beach	2,500	.....	S	
Krieger Oil Co. of Calif., Clearwater	3,000	.....	S	
McCallen Ref. Co., Huntington Beach	4,000	.....	S	
Macmillan Pet. Corp., Long Beach	7,500	.....	S	
Mangold & Tweedy Ref. Co., Long Beach	2,500	.....	S	
Mercury Pet. Corp., Venice	2,500	.....	S-A	
Mohawk Pet. Co., Bakersfield	12,000	1,500	S-C-A	Own
Norwalk Co., Maricopa	5,000	.....	S	
Operators Oil & Ref. Co., Long Beach	2,000	.....	S	
Pacific Central Ref. Co., Santa Maria	1,500	.....	S-A	
Pacific States Oil Co., Wilmington	7,000	600	S-C	Own
Palomar Ref. Co., Bakersfield	1,500	.....	S-L-A	
Paraffine Cos., Inc., Emeryville	1,400	.....	S-A	
Petrol Corp., Los Angeles	6,000	.....	S-A	
Petrol Corp., Roadamite (Santa Maria)‡	1,500	.....	S-A	
Petrol Corp., Santa Maria	1,500	.....	S-A	
Richfield Oil Corp., Watson	80,000	13,000	Comp.	Sinclair, Black
Rothschild Oil Co., Santa Fe Springs	5,500	1,300	S-C	Dubbs
San Fernando Ref. Co., Newhall	2,200	.....	S-A	
Seaside Oil Co., Summerland†	200	.....	S-A	
Seaside Oil Co., Ventura	4,000	.....	S-A	
Shell Oil Co., Inc., Martinez	29,700	7,200	S-C-L-A	Dubbs-Own
Shell Oil Co., Inc., Oil Fields	6,700	.....	S	
Shell Oil Co., Inc., Wilmington	35,000	12,300	S-C-A	Dubbs
Socal Oil & Ref. Co., Huntington Beach	1,750	*1,200	S-C	Dubbs
Standard Oil Co. of Calif., El Segundo	100,000	9,500	S-C-L-A	Dubbs
Standard Oil Co. of Calif., Richmond	100,000	11,500	S-C-L-A	Dubbs
Standard Oil Co. of Calif., Seguro	25,000	.....	S-A	
Texas Co. of Calif., Los Angeles	32,000	4,700	S-C	Holmes-Manley
Texas Co. of Calif., Fillmore	4,000	1,000	S-C	Cross
Tide Water Associated Oil Co., Avon	43,600	8,000	S-C-L-A	Tube & Tank
Tide Water Associated Oil Co., Watson	14,000	400	S-C	Vis. Breaking
Tierman Ref. Co., Long Beach	1,500	.....	S-A	
Union Oil Co., Wilmington	47,500	6,000	S-C-A	Cross
Union Oil Co., Maltha (Bakersfield)	8,000	.....	S-A	
Union Oil Co., Oleum	34,000	5,800	Comp.	Own, Gasoline Prod., Dubbs
Wilshire Oil Co., Inc., Norwalk	16,000	4,450	S-C	Dubbs
Yosemite Oil Ref. Co., Fruitvale	2,000	.....	S	
Total	829,150	.....		
Estimated cracked gasoline capacity		103,625		

*Raw charging capacity. †Rerun plant. ‡Leased from Gilmore Oil Co.

COLORADO

Bay Pet. Corp., Denver	5,000	1,150	S-C	Dubbs
Continental Oil Co., Denver	2,700	*1,500	S-C	Cross
Gramps Oil & Ref. Co., Alamosa	1,250	300	S-C	Dubbs
Midland Oil Ref. Co., Denver	1,000	.....	S-A	
Oriental Ref. Co., Denver	2,000	.....	S	
Perry Pet. Co., Denver	1,000	.....	S	
Raven Oil & Ref. Co., Rangely	125	.....	S	
Texas Co., Craig	3,000	1,500	S-C	Holmes-Manley
Universal Refineries, Inc., Pueblo	1,000	.....	S	
Total	17,075	.....		
Estimated cracked gasoline capacity		3,700		

*Raw-charge capacity.

DELAWARE

Texas Co., Claymont	3,500	.....	S-A	

GEORGIA

Mexican Pet. Corp. of Georgia, Savannah	4,000	.....	S-A	

IDAHO

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery	Type of cracking plant
Gem State Ref. Co., Twin Falls	300	.....	S	
Idaho Ref. Co., Pocatello	2,000	750	S-C-A	T.V.P.
Total	2,300	.....		
Estimated cracked gasoline capacity		750		

ILLINOIS

Advance Ref. Co., Inc., Centralia	3,250	.....	S	
Allied Oil Corp. of Illinois, St. Elmo	4,000	600	S-C	Own
Arrow Pet. Co., Centralia	3,000	.....	S	
Calumet Ref. Co., Burnham	1,200	.....	S-C-L	Schulze high vacuum
Cascade Ref. Co., Salem	3,000	600	S-C	Donnelly
Cross, Henry H. Co., Colmar	1,000	.....	S	
Cross, Henry H. Co., Dupo	1,000	.....	S	
Globe Oil & Ref. Co. (Ill.), Lemont	27,000	5,500	S-C	Winkler-Koch
Indian Ref. Co., Lawrenceville	28,000	8,300	Comp.	DeFlorez-Texas
Milan Ref. Co., Milan	3,000	.....	S	
Ohio Oil Co., Robinson	13,000	*6,500	S-C-A	Holmes-Manley and Kellogg
Pana Ref. Co., Pana	4,000	*1,650	S-C	Dubbs
Shell Oil Co., Inc., Wood River	75,000	33,000	S-C-L-A	Dubbs, Cross, T.V.P.
Socony-Vacuum Oil Co., Inc., E. St. Louis	16,000	4,400	S-C	Pratt V.P., Houdry
Standard Oil Co. (Ind.), Wood River	26,000	6,400	S-C-L-A	Holmes-Manley
Texas Co., Lockport	45,000	15,500	Comp.	Holmes-Manley, DeFlorez, Press. Coke
Transport Oil & Ref. Co., Dupo	1,100	.....	S-A	
Wireback, B. F., Colmar	500	.....	S	
Wood River Oil & Ref. Co., Inc., Hartford	15,000	3,000	S-C-A	Winkler-Koch
Worth Ref. Co., Blue Island	6,000	*2,000	S-C	Own
Total	276,050	.....		
Estimated cracked gasoline capacity		82,375		

*Raw-charge capacity.

INDIANA

Cities Service Oil Co. (Del.), E. Chicago	30,000	11,000	S-C	Cities Service
Evansville Ref. Co., Evansville	2,500	.....	S	
Indiana Farm Bureau Coop. Assn., Inc., Mount Vernon	2,500	.....	S	
Johnson Oil Supply, Gary	1,500	.....	S	
Rock Island Ref. Corp., Rock Island	6,000	*2,200	S-C	Winkler-Koch
Sinclair Ref. Co., East Chicago	53,000	12,200	S-C-L-W	Sinclair 600
Socony-Vacuum Oil Co., Inc., E. Chicago	17,000	3,900	S-C	Comb. Vis. Breaker-Kellogg
Standard Oil Co. (Ind.), Whiting	119,000	47,700	Comp.	Holmes-Manley, Cross Comb.
Troy Ref. Corp., Troy	950	.....	S	
Total	232,450	.....		
Estimated cracked gasoline capacity		75,900		

*Raw-charge capacity.

KANSAS

Anco Ref. Co., Inc., Garnett	750	.....	S	
Bareco Oil Co., Wichita	6,000	1,325	S-C	Dubbs
Bay Pet. Corp., McPherson	5,000	*2,500	S-C	Dubbs
Chanute Ref. Co., Chanute	.....	550	C	Jenkins
Cooperative Ref. Assoc., Phillipsburg	3,450	640	S-C	Dubbs
Derby Oil Co., Wichita	8,000	2,000	S-C-A	Dubbs
El Dorado Ref. Co., El Dorado	8,500	*4,000	S-C	Winkler-Koch
Falcon Ref. Co., Great Bend	2,000	.....	S	
Globe Oil & Ref. Co., McPherson	15,000	*4,000	S-C-L	Winkler-Koch
H. & T. Refinery, Chase	2,000	.....	S	
Kanotex Ref. Co., Arkansas City	9,000	1,800	S-C-A	Donnelly
National Ref. Co., Coffeyville	9,500	2,500	S-C-L-W	Dubbs
Phillips Pet. Co., Kansas City	23,000	12,000	S-C	Own-Dubbs
Plains Oil & Ref. Corp., Great Bend	2,200	.....	S	
Shallow Water Ref. Co., Shallow Water	2,000	250	S-C-A	Winkler-Koch
Sinclair Ref. Co., Coffeyville	11,000	3,200	S-C-L-W	Sinclair 600
Sinclair Ref. Co., Kansas City	10,000	3,700	S-C	Sinclair 600
Skelly Oil Co., El Dorado	25,000	8,000	S-C-L-A	Winkler-Koch
Socony-Vacuum Oil Co., Augusta	22,500	10,000	S-C-A	Houdry-Control Coil
Standard Oil Co. (Ind.), Neodesha	7,700	2,640	S-C	Combination
Vickers Pet. Co., Potwin	4,500	1,250	S-C	Dubbs
Workman Oil & Ref. Co., McCune	100	.....	S	
Total	177,200	.....		
Estimated cracked gasoline capacity		61,105		

*Raw-charge capacity.

KENTUCKY

Aetna Oil Co., Louisville	8,500	1,000	S-C	Gasoline Prod.
Ashland Oil & Ref. Co., Catlettsburg	16,000	3,500	S-C-L-A	Dubbs
Greenville Ref. Co., Inc., Greenville	50	.....	S	
Latonia Oil Corp. (Standard Oil of Ohio), Covington	14,000	5,300	S-C-A	Tube & Tank
Louisville Ref. Co., Inc., Louisville	7,000	*2,500	S-C	Dubbs
South Ky. Pipe Line Co., Somerset	400	.....	S	
Stoll Oil Ref. Co., Louisville	2,000	.....	S-L-W	
Texas Co., Pryse	5,000	2,000	S-C	Holmes-Manley
Tri-State Refineries, Inc., Spottsville	1,000	.....	S	
Total	53,950	.....		
Estimated cracked gasoline capacity		13,050		

*Raw-charge capacity.

LOUISIANA

Arkansas Fuel Oil Co., Bossier City	23,000	*5,500	S-C	Tube & Tank, Lareco Comb.
Atlas Oil & Ref. Co., Shreveport	12,000	*6,000	S-C	Gyro
Bayou State Oil Corp., Hosston	800	.....	S-L-A	
Chalmette Pet. Corp., Chalmette	8,000	*2,500	S-C	Cross Comb.
Continental Oil Co., West Lake	8,000	*4,000	S-C	Cross
Evangeline Ref. Co., Jennings	1,000	.....	S	
Evansville Oil Corp., Cotton Valley	2,000	.....	S	
General Oil Corp., Meraux	5,000	.....	S	
Pan American Pet. Corp., Destrehan	7,500	.....	S-A	
Premier Oil Ref. Co. of Tex., Cotton Valley	5,000	.....	S	

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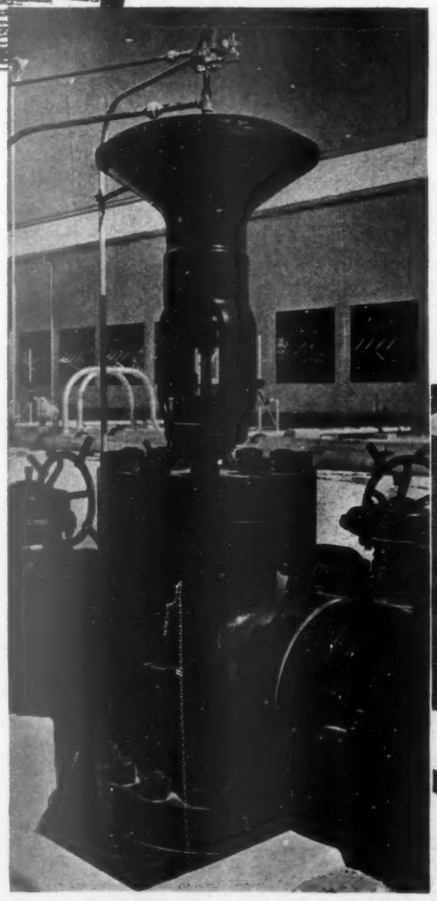
8" Fisher Type 57T specially designed diaphragm control valve. Operates as emergency shut-off valve for an entire gulf coast recycling plant.



Fisher Governor Company offers you the ideal source of complete Automatic Control Equipment . . . all from one source of supply and with one responsibility for satisfactory operation. Fisher Automatic Controls include: Diaphragm Valves . . . Liquid Level Controllers . . . Drainers . . . Lever Valves . . . Float Valves . . . Reducing Valves . . . Relief Valves . . . Boiler Gas Fuel Governors . . . Pump Governors . . . Safety Shut-Off Valves . . . Strainers . . . Traps.

Every Fisher control is individually built to meet your exact operating conditions thereby insuring best possible results. Fisher engineers will gladly recommend the control equipment best suited to your requirements.

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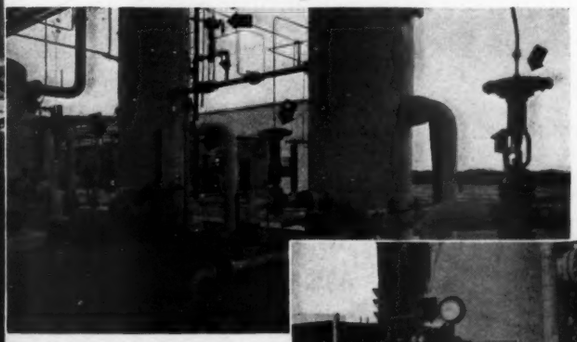

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MARSHALLTOWN, IOWA

LOUISIANA (Continued)

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery	Type of cracking plant
Princeton Ref. Corp., Princeton	600	.....	S-L-A	
Shell Oil Co., Inc., Norco	21,000	6,200	S-C-A	Dubbs
Standard Oil Co. of La., Baton Rouge	120,000	22,550	Comp.	Cross-Link
Stanolind Oil & Gas Co., Superior	3,300	*1,800	S-C	Cross
Total	217,200	.....		
Estimated cracked gasoline capacity	.....	38,650		

*Raw-charge capacity.

MARYLAND

Continental Oil Co., Baltimore	7,500	*3,500	S-C-A	Cross
Pan American Ref. Corp., Baltimore	8,000	.....	S-A	
Standard Oil Co. of N. J., Baltimore	37,000	7,300	S-C-L-A	Tube & Tank
Total	52,500	.....		
Estimated cracked gasoline capacity	.....	7,150		

*Raw-charge capacity.

MASSACHUSETTS

Cities Service Oil Co. (Pa.), E. Braintree	20,000	7,700	Comp.	Cities Service
Colonial Beacon Oil Co., Everett	34,860	7,650	S-C-A	Tube & Tank
Total	54,860	.....		
Estimated cracked gasoline capacity	.....	15,350		

MICHIGAN

Aurora Gasoline Co., Detroit	5,000	1,500	S-C	Dubbs
Aurora Gasoline Co., Elsie	3,000	.....	S	
Bay Ref. Corp., Bay City	4,350	.....	S	
Crystal Ref. Co., of Carson City, Inc., Carson City	6,000	.....	S	
Essex Ref. Co., Bay City	2,000	.....	S	
Fort Dale Oil & Ref. Co., Bloomingdale	1,500	.....	S	
General Ref. Co., Grand Haven	750	.....	S	
Petroleum Specialties, Inc., Flat Rock	3,000	750	S-C	Dubbs
Lakeside Ref. Co., Kalamazoo	1,700	.....	S	
Leonard Refineries, Inc., Alma	3,000	650	S-C-A	Dubbs
Leonard Refineries, Inc., St. Louis	4,000	1,150	S-C-A	Dubbs
Marvel Ref. Co., Grand Rapids	2,000	.....	S	
Mid-West Refineries, Inc., Alma	3,000	*1,800	S-C	Dubbs
Mid-West Refineries, Inc., Grandville	4,000	*2,000	S-C	Dubbs
Naph-Sol Ref. Co., Muskegon	5,000	800	S-C	Dubbs
Old Dutch Ref. Co., Muskegon	4,000	600	S-C	Dubbs
Peerless Ref. Co., Saginaw	700	.....	S	
Petroleum Specialties, Inc., Flat Rock	3,000	750	S-C	Dubbs
Producers Ref. Co., Inc., West Branch	3,500	.....	S-A	
Pure Oil Co., Midland	3,300	.....	S	
Roosevelt Oil Co., Mount Pleasant	5,000	600	S-C	Kellogg
Socony-Vacuum Oil Co., Trenton	25,000	10,000	S-C	Houdry, Delayed Coking, Vapor Phase
Sweet Oil Ref. Co., Wyman	1,500	.....	S	
Trumbull Asphalt & Ref. Co., W. Branch	1,000	.....	S-A	
Total	95,300	.....		
Estimated cracked gasoline capacity	.....	18,700		

*Raw-charge capacity.

MINNESOTA

Northwestern Ref. Co., St. Paul Park	3,000	.....	S	
Purzone, Inc., Minneapolis	4,500	.....	S	
Total	7,500			

MISSISSIPPI

Johnston, E. C., Vicksburg	4,000	.....	S	
Paluxy Asphalt Co., Crupe	3,000	.....	S	
Total	7,000			

MISSOURI

Joplin Ref. Co., Joplin	500	.....	S	
Standard Oil Co. (Ind.), Sugar Creek	24,600	6,820	S-C-A	Holmes-Manley
Total	25,100	.....		
Estimated cracked gasoline capacity	.....	6,820		

MONTANA

Arro Oil & Ref. Co., Lewistown	1,500	250	S-C	Dubbs
Bears Den Refinery, Chester	50	.....	S	
Big West Oil Co. of Montana, Kevin	1,500	*750	S-C	Dubbs
Continental Oil Co., Lewistown	1,225	.....	S	
Cut Bank Ref. Co., Cut Bank	1,100	.....	S	
Gallatin Valley Cooperative Co., Belgrade	350	.....	S	
Glacier Prod. Co., Cut Bank	4,500	*2,400	S-C	Dubbs
Hart Refineries, Missoula	300	100	S-C	Own
Hill County Refinery, Havre	500	.....	S	
Hole Bros. Refinery, Cut Bank	350	.....	S	
Home Oil & Ref. Co., Great Falls	2,500	*1,100	S-C-A	Dubbs
Hunt, Eugene, Winnett	400	.....	S	
Independent Ref. Co., Laurel	7,500	1,650	S-C-A	Dubbs
North American Ref. Co., Chinook	400	.....	S	
Northwest Ref. Co., Cut Bank	4,500	850	S-C	Dubbs
Patterson, H. F., Ref. Co., Sweet Grass	800	.....	S	
Pondera Valley Refinery, Pondera field	75	.....	S	
Production Ref. Corp., Shelby	2,500	.....	S	
Sandgren & Nyhagen, Cut Bank	40	.....	S	
Sun River Refinery (Manchester), Great Falls	100	.....	S	
Sweet Grass Oil & Ref. Co., Sweet Grass	600	.....	S	
Texas Co. (International Ref. Co.), Sunburst	7,000	2,500	S-C	De Florez
Treasure State Ref. Co., Shelby	350	.....	S	
Unity Pet. Corp., Kalispell	800	.....	S	
Whitlash Ref. Co., Whitlash	30	.....	S	
Yale Oil Corp., Billings	8,000	.....	S-L-A	
Yale Oil Corp., Kalispell	1,000	.....	S	
Total	47,970	.....		
Estimated cracked gasoline capacity	.....	7,475		

*Raw-charge capacity.

NEBRASKA

Carpenter, Terry, Inc., Scottsbluff	1,200	*600	S-C	Dubbs
Cooperative Refinery Assn., Scottsbluff	1,325	240	S-C	Dubbs
Gordon Ref. Co., Gordon	100	.....	S	
Mid-States Ref. Co., Falls City	3,000	.....	S	
Nebraska Prod. & Ref. Co., Salem	1,800	.....	S	
Petroleum Utilities Co., Inc., Chadron	700	.....	S	

NEBRASKA (Continued)

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery	Type of cracking plant
Porter Oil Co., Sidney	300	.....	S	
Searle Pet. Co., Omaha	1,000	.....	S	
Total	9,425	.....		
Estimated cracked gasoline capacity	.....	540		

*Raw-charge capacity.

NEW JERSEY

Barber Asphalt Corp., Barber	13,500	1,600	S-C-A	Cross
Cities Service Oil Co. (Pa.), (Petty Island), Camden	20,000	4,500	S-C	Cities Service
Cities Service Oil Co. (Pa.), Linden	12,000	.....	S-A	
Socony-Vacuum Oil Co., Paulsboro	25,200	8,000	Comp.	Houdry
Standard Oil Co. of N. J., New Jersey Works (Bayonne, Linden, N. J.)	124,000	35,000	Comp.	Tube & Tank
Tide Water Associated Oil Co., Bayonne	57,000	8,300	S-C-L-W	Tube & Tank
Total	251,700	.....		
Estimated cracked gasoline capacity	.....	57,400		

NEW MEXICO

Aerex Co., Bloomfield	100	.....	S	
Basin Ref. Co., Aztec	100	.....	S	
Continental Oil Co., Artesia	1,500	*640	S-C	Cross
Continental Oil Co., Farmington	750	.....	S	
Malco Refineries, Inc., Artesia	2,500	1,000	S-C	Dubbs
McNutt Oil & Ref. Co., Brickland	1,500	300	S-C	Donnelly
Petroleum Products Ref. Co., Prewitt	1,500	525	S-C	Own
Valley Ref. Co., Roswell	1,200	300	S-C-A	Dubbs
Total	9,150	.....		
Estimated cracked gasoline capacity	.....	2,445		

*Raw-charge capacity.

NEW YORK

Allegany Refineries, Inc., Bolivar	1,050	.....	S-L-W	
Frontier Fuel Oil Corp., Tonawanda	7,000	*2,000	S-C	T-V-P
Gulf Oil Corp., Staten Island	13,000	.....	S	
Sinclair Ref. Co., Wellsville	9,000	1,300	S-C-L-W	Sinclair 600
Socony-Vacuum Oil Co., Brooklyn and Long Island City	19,000	5,200	Comp.	Houdry, De Florez, Cross
Socony-Vacuum Oil Co., Buffalo	16,000	7,200	Comp.	Houdry, De Florez
Socony-Vacuum Oil Co., Olean	6,500	.....	S-L	
Total	71,550	.....		
Estimated cracked gasoline capacity	.....	14,700		

*Raw-charge capacity.

OHIO

Canfield Oil Co., Coraopolis	1,000	.....	S-L	
Canton Ref. Co., Canton	7,000	1,500	S-C	Dubbs
Gulf Ref. Co., Cleves	20,900	*14,000	S-C-A	Gulf
Gulf Ref. Co., Toledo	19,700	*10,000	S-C	Gulf
National Ref. Co., Findlay	9,000	*3,200	Comp.	Dubbs
Pure Oil Co., Newark	13,400	5,700	S-C	Comb. H.P. & Cross
Pure Oil Co., Toledo	25,000	9,700	S-C	Comb. H.P.
Standard Oil Co. (Ohio), Cleveland	28,000	*9,700	Comp.	Tube & Tank
Standard Oil Co. (Ohio), Lima	10,500	*4,000	S-C	Tube & Tank
Standard Oil Co. (Ohio), Toledo	25,000	*7,200	S-C-L	Kellogg Comb.
Sun Oil Co., Toledo	30,000	12,000	S-C	Own Houdry
Total	189,500	.....		
Estimated cracked gasoline capacity	.....	52,950		

*Raw-charge capacity.

OKLAHOMA

Allied Materials Corp., Stroud	1,500	.....	S-L-A	
Anderson-Prichard Ref. Corp., Cyril	8,000	3,000	S-C-A	Winkler-Koch
Bareco Oil Co., Barnsdall	5,000	1,200	S-C-L-W	Cross
Bell Oil & Gas Co., Granfield	5,000	1,250	S-C	Dubbs
Ben Franklin Ref. Co., Ardmore	4,500	1,360	S-C-A	Dubbs
Black Gold Ref. Co., Oklahoma City	2,000	*1,000	S-C	Dubbs
Champlin Ref. Co., Enid	16,000	*4,000	S-C-L-W	Own
Cities Service Oil Co. (Del), Ponca City	11,000	2,500	Comp.	Dubbs-Cities Service
Continental Oil Co., Ponca City	26,000	*14,500	S-C-L-W	Cross
Cosco Oil Co., Wynnewood	3,000	575	S-C-A	Dubbs
Cushing Ref. & Gaso. Co., Cushing	4,500	900	S-C	Dubbs
Deep Rock Oil Corp., Cushing	10,000	2,500	Comp.	Dubbs
Johnson Oil Ref. Co., Cleveland	5,500	1,650	S-C	Dubbs
Mid-Continent Pet. Corp., West Tulsa	40,000	8,000	Comp.	Own
Monarch Refineries, Inc., Oklahoma City	1,000	.....	S-A	
Peppers Gasoline Co., Oklahoma City	500	.....	S	
Phillips Pet. Co., Okmulgee	6,000	*1,500	S-C-L	Dubbs
Rock Island Ref. Co., Duncan	8,000	2,500	S-C-A	Winkler-Koch
Shale Oil Co., Lawton	80	.....	S	
Sinclair Ref. Co., Sand Springs	4,500	500	S-C-L-W	Cross
Texas Co., West Tulsa	19,000	6,000	Comp.	Holmes-Manley
Tide Water Associated Oil Co., Drumright	12,000	2,300	S-C	Tube & Tank
Wilcox, H. F., Oil & Gas Co., Bristow	5,500	*2,200	S	Dubbs
Total	198,580	.....		
Estimated cracked gasoline capacity	.....	45,775		

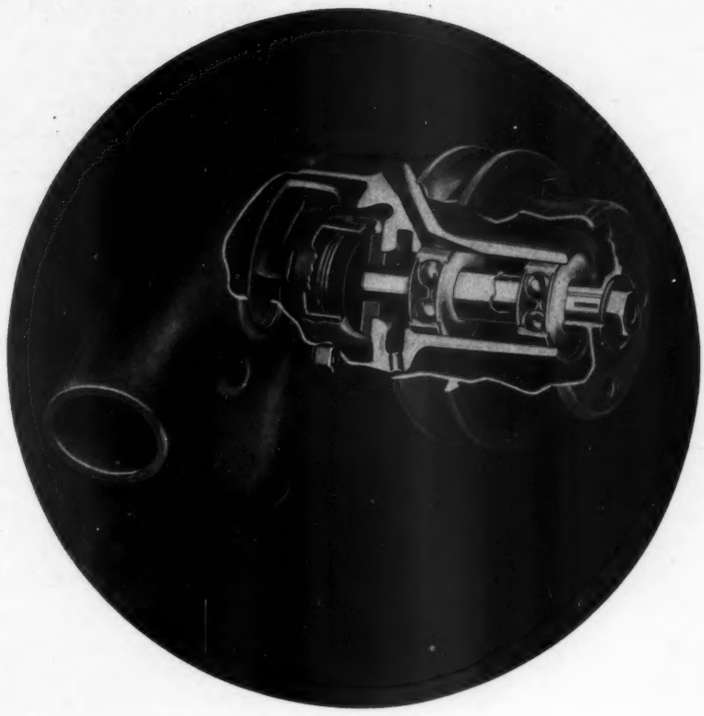
*Raw-charge capacity.

PENNSYLVANIA

Atlantic Ref. Co., Philadelphia	95,000	25,700	Comp.	Lewis, Cross, De Florez Comb.
Berry, James B., Sons Co., Inc.	2,500	*1,200	S-C-L-W	Dubbs
Bradford Penn Ref. Corp., Clarendon	1,500	.....	S-L-W	
Canfield Oil Co., Coraopolis	1,000	.....	S-L	
Cities Service Oil Co. (Pa.), Titusville	3,000	.....	S-L-W	
Conewango Ref. Co., Warren	.....	.....	L	
Continental Ref. Co., Oil City	900	200	S-C-L-W	Dubbs
Daugherty Ref., Petrolia	4,000	.....	S-L	
Franklin Creek Ref. Corp., Franklin	2,000	.....	S-L-W	
Freedom Oil Co., Freedom	3,000	600	S-C-L-W	Dubbs
Gulf Oil Corp., Philadelphia	50,000	*25,000	S-C-L	Gulf
Gulf Oil Corp., Pittsburgh	11,800	*6,000	S-C-L	Gulf
Kendall Ref. Co., Bradford	5,000	*2,200	S-C-L-W	Dubbs
Penna. Oil Prod. Ref. Co., Eldred	3,000	500	Comp.	Own
Pennsylvania Ref. Co., Karns City	1,500	.....	S-L-W	
Pennsylvania Ref. Co., Titusville	2,000	.....	S-L-W	
Pennzoil Co., Oil City	.....	5,500	C	Dubbs

Continental Red Seal Engines from 5 to 150 H.P.

Internally Sealed Water Pump!



This internally sealed NO-LEAK water pump prevents disastrous leakage. The impeller is mounted on ball bearings to maintain alignment and the carbon seal prevents leakage by centrifugal action.

Other important features in Red Seal Continental Engines for oil field service are — directional cooling — full length water jacket — interchangeable bearings — counterweighted crankshaft with precise balancing — pressure lubricated barrel-type tappets — and individual porting for quick starting, maximum power, economy and flexibility.

Sales and Service Facilities

Dallas: National Welding & Grinding Co.
Houston: C. Jim Stewart & Stevenson Co.
Longview: Standard Tool & Machine Co.
Wichita Falls: Wichtex Machinery Co.

CONTINENTAL MOTORS — Powering the Nation — AMERICA'S STANDARD

Continental Motors Corporation

MUSKEGON, MICHIGAN

PENNSYLVANIA (Continued)

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery	Type of cracking plant
Pennzoil Co., Rouseville	8,500	.....	S-L-W	
Quaker State Oil Ref. Corp., Emlenton	1,800	*1,200	S-C-L-W	Dubbs
Quaker State Oil Ref. Corp., Bradford	3,500	*1,500	S-C-L-W	Dubbs
Sherwood Ref. Co., Warren	800	.....	S	
Sinclair Ref. Co., Marcus Hook	55,000	11,500	S-C	Sinclair 600
Sun Oil Co., Marcus Hook	90,000	36,000	Comp.	Own-Houdry
Superior Oil Works, Warren	500	.....	S-L-W	
Ultra-Penn Ref. Co., Bruin	1,000	.....	S-L	
United Ref. Co., Warren	5,500	*2,200	S-C-L-W	Dubbs
Valvoline Oil Co., Butler	2,500	.....	S-L-W	
Waverly Oil Works Co., Pittsburgh	2,500	.....	S-L-W	
Wolf's Head Oil Ref. Co., Inc., Reno	2,500	475	S-C-L-W	Dubbs
Total	360,300	.....		
Estimated cracked gasoline capacity	.....	100,125		

*Raw-charge capacity.

RHODE ISLAND

Socony-Vacuum Oil Co., Inc., E. Providence	5,500	750	S-C-A	Cross
Texas Co., Providence	3,500	.....	S-A	
Total	9,000	.....		
Estimated cracked gasoline capacity	.....	750		

SOUTH CAROLINA

Standard Oil Co. of N. J., Charleston	6,000	.....	S-A	

SOUTH DAKOTA

Belle Ref. Co., Belle Fourche	50	.....	S	
Hot Springs Ref. Co., Hot Springs	200	.....	S	
Rex Oil Refinery, Rapid City	60	.....	S	
Sturgis Ref. Co., Sturgis	100	.....	S	
Total	410			

TENNESSEE

Delta Ref. Co., Memphis	3,500	900	S-C-A	Dubbs
Estimated cracked gasoline capacity		900		

TEXAS

American Mineral Spirits Co., Corpus Christi	10,000	.....	S	
American Republics Corp., Houston	10,000	.....	S	
Atlantic Ref. Co., Atreco	23,900	9,500	S-C	Combination
Baird Ref. Co., Baird	2,000	600	S-C	Own
Bareco Oil Co., Corpus Christi	10,000	2,600	S-C	Dubbs
Bryson Pipe Line & Ref. Co., Bryson	2,500	.....	S-L	
Coastal Refineries, Inc., Port Isabel	7,000	1,000	S-C	Rowsey
Col-Tex Ref. Co., Colorado City	12,500	1,750	S-C-A	Dubbs
Continental Oil Co., Wichita Falls	5,000	*2,600	S-C	Cross
Cosden Pet. Corp., Big Spring	15,000	6,600	S-C	Dubbs
Cosden Pet. Corp., Graham	2,500	.....	S	
Crown Central Pet. Corp., Houston	16,000	*8,000	S-C-L	Holmes-Manley
Danciger Oil & Refineries, Inc., Pampa	7,000	2,300	S-C	Dubbs
Danube Oil Corp., Borger	1,000	300	S-C	
Eastern States Pet. Co., Inc., Houston	20,000	3,000	S-C	Comb.
Gladewater Ref. Co., Gladewater	3,000	800	S-C	Own
Golden West Oil Co., Hondo	100	.....	S	
Gratex Ref. & Fuel Oil Co., Graham	500	.....	S	
Gulf Oil Corp., Fort Worth	7,200	*4,000	S-C	Gulf
Gulf Oil Corp., Port Arthur	148,000	*75,000	S-C-L-W	Gulf
Gulf Oil Corp., Sweetwater	6,400	*4,000	S-C	Gulf
Hammon Exploration Co., Bay City	3,000	.....	S	
Heffington Pet. Co., Austin	200	.....	S	
Houston Oil Co. of Texas, Viola	500	.....	S	
Humble Oil & Ref. Co., Baytown	185,000	37,500	S-C-L-A	Tube & Tank, Cross
Humble Oil & Ref. Co., Ingleside	35,000	7,800	S-C	Tube & Tank
Humble Oil & Ref. Co., Neches	5,000	.....	S	
Humble Oil & Ref. Co., San Antonio	5,600	.....	S	
Independent Ref. Co., Arp	3,500	750	S-C	Own
Jacksboro Ref. Co., Jacksboro	250	.....	S	
Lacy, Roger, Refinery, Kilgore	2,500	*1,000	S-C	
La Salle Pet. Corp., Burkburnett	2,500	.....	S	
Lynch Ref. Co., Kilgore	5,000	1,000	S-C	Own
McBride Ref. Co., Inc., LaBlanca (Edinburg)	1,200	.....	S	
Magnolia Pet. Co., Beaumont	105,000	27,900	S-C-L-W	Houdry, Cross
Magnolia Pet. Co., Fort Worth	12,000	5,400	S-C	Cross
Maritime Oil Co., Houston	5,000	.....	S	
Master Pet. Co., Dallas	1,500	.....	S	
Mertzon Ref. Co., Mertzon	200	.....	S	
Minerva Ref. Co., Minerva	1,250	.....	S	
Motor Fuels Corp., Levelland	3,500	*2,700	S-C	Dubbs
Moutray Oil Co., Hawley	1,000	130	S-C	Own
Muenster Ref. Co., Muenster	1,500	.....	S	
Nueces Ref. Co., Clarkwood	2,500	.....	S	
Olney Oil & Ref. Co., North Olney	2,000	900	S-C	Donnelly
Onyx Ref. Corp., Abilene	2,000	350	S-C	Own
Pan American Ref. Corp., Texas City	97,000	37,000	S-C	Combination
Panhandle Ref. Co., Lueders	1,500	330	S-C	Dubbs
Panhandle Ref. Co., Wichita Falls	4,000	960	S-C	Dubbs
Patton Oil Co., Rotan	800	.....	S	
Payward Ref. Co., Shamrock	1,000	.....	S	
Pettus Oil & Ref. Co., Pettus	1,000	.....	S	
Phillips Pet. Co., Borger	35,000	*17,000	S-C	Own
Phillips Pet. Co., Penwell	1,000	*750	S-C	Own
Phoenix Ref. Co., Houston	2,500	.....	S	
Pioneer Oil & Ref. Co., Somerset	1,400	.....	S-L-A	
Pontiac Ref. Corp., Corpus Christi	10,500	.....	S	
Premier Oil Ref. Co. of Texas, Fort Worth	4,000	700	S-C-L-W	Kellogg
Premier Oil Ref. Co. of Texas, Longview	4,000	1,400	S-C	Own
Prichard Ref. Co., Ltd., San Antonio	3,000	*1,000	S-C	Own
Pure Oil Co., Nederland	48,700	14,800	S-C	Comb. H.P. & Cross
Rado Ref. Co., McAllen	1,000	.....	S	
Reischman, R. T., Ref. Co., Fort Stockton	500	.....	S	
Refugio Ref. Co., Refugio	1,000	.....	S	
Reischman, R. J., Ref. Co., Fort Stockton	500	.....	S	
Republic Oil Ref. Co., Texas City	20,000	4,500	S-C	Winkler-Koch
Shamrock Oil & Gas Corp., Sunray	3,300	1,385	S-C	Dubbs
Shell Oil Co., Inc., Houston	74,000	21,900	S-C	Dubbs
Shelly Ref. Co., Inc., Bay City	1,500	205	S-C	Own
Sinclair Ref. Co., Fort Worth	5,500	1,700	S-C	Sinclair 600
Sinclair Ref. Co., Houston	73,000	15,500	S-C-L-W	Sinclair 600
Skelly Oil Co., Longview	10,000	2,600	S-C	Donnelly
Southport Pet. Co. of Del., Texas City	14,000	20,000	Comp.	
Southwestern Oil & Ref. Co., Corpus Christi	14,000	.....	S	
Standard Oil Co. of Texas, El Paso	14,000	2,700	S-C	Dubbs
Star Light Ref. Co., Inc., Ballinger	600	.....	S	
Stone Oil Co., Texas City	7,500	.....	S	
Talco Asphalt & Ref. Co., Mount Pleasant	10,000	950	S-C-A	Dubbs
Taylor Ref. Co., Corpus Christi	22,500	1,500	S-C	Rowsey

TEXAS (Continued)

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery	Type of cracking plant
Terminal Ref. Corp., Corpus Christi	12,000	.....	S	
Texas Co., Amarillo	7,000	2,400	S-C	De Florez, Press. Coke
Texas Co., El Paso	2,000	1,000	S-C	Holmes-Manley
Texas Co., Houston	27,500	1,000	S-C	Tube & Tank
Texas Co., Port Arthur	135,000	52,000	Comp.	Holmes-Manley, De Florez, Press. Coke, Exp. Catalytic
Texas Co., Port Neches	40,000	.....	S-A	
Texas Co., San Antonio	6,000	2,200	S-C	Holmes-Manley
Texas Co., West Dallas	15,000	7,000	S-C	Holmes-Manley, De Florez, Press. Coke
Texas Pacific Coal & Oil Co., Caddo	400	.....	S	
Three Rivers Ref., Three Rivers	1,500	.....	S-L-A	
Tydal Ref. Co., Gainesville	1,500	.....	S	
Uvalde Rock Asphalt Co., Blewett	500	.....	S	
Waggoner, W. T., Estate, Electra	4,000	900	S-C	Dubbs
Western Ref. Co., Fort Stockton	1,000	.....	S	
Wickett Ref. Co., Wickett	4,000	.....	S	
Total	1,442,000	.....		
Estimated cracked gasoline capacity	.....	359,835		

*Raw-charge capacity.

UTAH

Equity Oil Co., Vernal (Jensen)	500	.....	S	
Utah Oil Ref. Co., Salt Lake City	8,000	2,550	Comp.	Modified Holmes-Manley
Wasatch Oil Ref. Co., Woods Cross	2,500	900	S-C-A	Vapor Phase
Total	11,000	.....		
Estimated cracked gasoline capacity	.....	3,450		

VIRGINIA

Texas Co., Norfolk	2,000	.....	S-A	

WASHINGTON

Inland Empire Refineries, Inc., Spokane	3,500	1,200	S-C-A	Winkler-Koch
Montana Headlight Oil Co., Spokane	600	.....	S	
Total	4,100	.....		
Estimated cracked gasoline capacity	.....	1,200		

WEST VIRGINIA

Carbide & Carbon Chemicals Corp., South Charleston	2,500	500	S-C	Gyro
	3,500	600	S-C-L-W	Dubbs & T.V.P.
Elk Refining Co., Falling Rock	5,200	1,490	S-C-L-W	Gyro-Comb. H.P. & L.P.
Pure Oil Co., Cabin Creek				
Quaker State Oil Ref. Co., St. Marys	2,000	1,200	S-C-L-W	Dubbs
Total	13,200	.....		
Estimated cracked gasoline capacity	.....	3,790		

WISCONSIN

Wisconsin Oil Ref. Co., Inc., Sheboygan	6,000	.....	S	

WYOMING

Albany Oil & Ref. Co., Laramie	450	.....	S	
Beck Refinery, Cody	500	.....	S	
C. & H. Refinery, Lusk	80	.....	S	
Continental Oil Co., Glenrock	3,400	*1,800	S-C	Cross
Consumers Oil & Ref. Co., Newcastle	1,500	.....	S	
Crook County Refinery, Sundance	80	.....	S	
Davis Oil Co., Newcastle	75	.....	S	
Douglas Ref., Douglas	120	.....	S	
Elk Horn Gas Refinery, Osage	55	.....	S	
Empire State Oil Co., Thermopolis	1,500	.....	S-A	
Frontier Ref. Co., Cheyenne	1,850	*850	S-C	Dubbs
Gray Refinery, Inc., Newcastle	1,000	.....	S	
Husky Ref. Co., Cody	2,500	.....	S-A	
Moorcroft Ref. Co., Moorcroft	60	.....	S	
Northwestern Pet., Osage	100	.....	S	
Ohio Oil Co., Lovell	3,000	.....	S-A	
Pilot Oil Co., Morton	200	.....	S	
Powell Refinery, Powell	40	.....	S	
Ralston Refinery, Upton	50	.....	S	
Resolute Oil Corp., Badger Basin	800	200	S-C	Own
Silver Tip Refinery, Yoder	95	.....	S	
Sinclair Ref. Co., Parco	9,000	2,900	S-C-A	Sinclair 600
Socony-Vacuum Oil Co., Inc., Casper	5,000	1,000	S-C-A	Control Coil
Standard Oil Co. (Ind.), Casper	13,000	3,800	Comp.	Vapor Phase
Standard Oil Co. (Ind.), Greybull	4,100	1,000	S-C-A	Cross
Texas Co., Calpet†	350	.....	S	
Texas Co., Casper	7,000	3,600	S-C	Holmes-Manley, Press. Coke
Texas Co., Cody	3,000	.....	S-A	
Tri-State, Inc., Thermopolis	1,000	.....	S-A	
Wasatch Production Co., La Barge	125	.....	S	
Yale Oil Corp., Lovell	1,000	.....	S-A	
Yale Oil Corp., Worland	500	.....	S	
Z & W Service & Refinery, Torrington	85	.....	S	
Total	61,615	.....		
Estimated cracked gasoline capacity	.....	13,825		

*Raw-charge capacity. †To start operations May 1942.

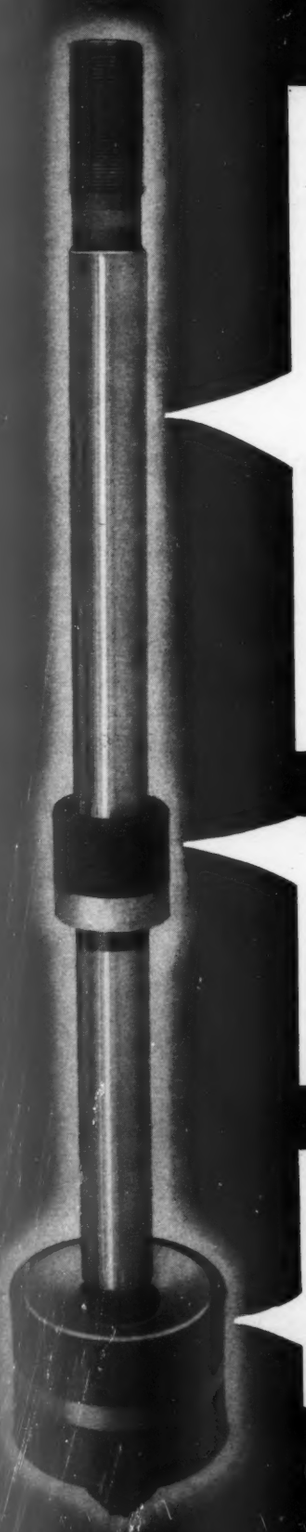
Operating Refineries in Mexico

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery	Type of cracking plant
Petroleos Mexicanos, Ciudad Madero	63,000	*8,500	Comp.	Dubbs-Gyro
Petroleos Mexicanos, Arbol Grande	15,000	.....	S-L-W	
Petroleos Mexicanos, Bella Vista	4,000	*1,100	S-C	Dubbs
Petroleos Mexicanos, Mata Redonda	9,000	*5,500	S-C	Kellogg
Petroleos Mexicanos, Poza Rica	7,500	.....	S	
Petroleos Mexicanos, Minatitlan†	30,000	*2,500	Comp.	Dubbs
Petroleos Mexicanos, Mexico City	20,000	.....	S	
T. Meza Moreno, P. y Aguacate	315	.....	S	
Refinerias Mexico, Nuevo Laredo	330	.....	S	
Refineria Laredo, Nuevo Laredo	190	.....	S	
Refineria Union, Monterrey	160	.....	S	
Refineria del Norte, Cd. Juarez	1,000	.....	S	
Total	150,495	.....		
Estimated cracked gasoline capacity	.....	8,800		

*Raw-charge capacity. †Operating skimming unit only.

For Longer Trouble-Free

PUMP PERFORMANCE



MISSION *Super-Surfaced* PISTON RODS

. . . stay in your pumps from two to four times longer. This extra long life is due to the *double wearing surface.*

Wearing Surface No. 1

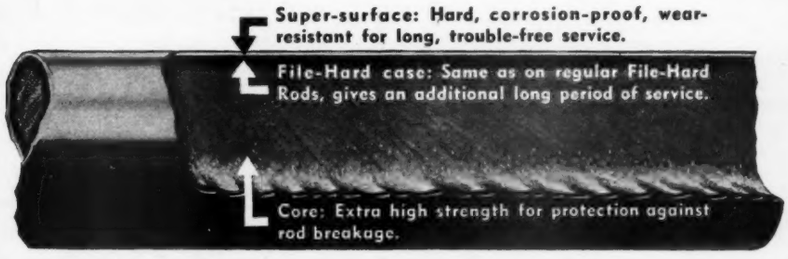
This hard, corrosion-proof, wear-resistant super-surface lasts longer than the regular File-Hard Rod under ordinary conditions . . . and up to three times longer under corrosive conditions.

Wearing Surface No. 2

When the super-surface is finally worn off, a regular Mission File Hard Surface remains to give you another long period of service.

Longer Rod Life Means Lower Rod Costs

From two to four times longer life at only about a 45% increase in price . . . This means lower rod costs any way you figure it; in most instances at least a two to one saving. Install these rods in your pumps and start saving right away.


Super-surface: Hard, corrosion-proof, wear-resistant for long, trouble-free service.
File-Hard case: Same as on regular File-Hard Rods, gives an additional long period of service.
Core: Extra high strength for protection against rod breakage.

MISSION *Self-Sealing* GLAND PACKINGS

. . . seal perfectly regardless of pump pressure. This means longer rod and packing wear as well as freedom from frequent tightening of gland nuts.

Self-Sealing Principle: This outstanding performance is possible because pump pressure, acting on the packing lip, gives a seal which varies with pressure—there is no binding at low pressures—no leakage at high pressures.

Order several sets of Mission Self-Sealing Gland Packings. They will make your rods last longer and save you trouble.

MISSION FLUID END PISTONS

. . . save you the cost of the piston body every time you change rubbers. With Mission, you simply dress up the piston body with new rubbers.

You get a double saving because, in addition to saving piston body costs, the tough, durable Mission Piston Rubbers stay in your pumps longer.

"Change the Rubbers and Save the Piston."

MISSION MANUFACTURING CO.
Humble Road Houston, Texas
EXPORT OFFICE: 30 Rockefeller Plaza, New York

MISSION
SLUSH PUMP PARTS

Operating Refineries in Canada

ALBERTA

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery	Type of cracking plant
Becker Refineries, Ltd., Royalties	500	.....	S	
British American Oil Co., Ltd., Calgary	5,000	*2,500	S-C-A	Winkler-Koch
Comet Ref. Co., Ltd., Red River	250	.....	S	
Dina Oil & Ref. Co., Ltd., Dina	500	.....	S	
Fraser, J. W., Ref. Co., Wainwright	100	.....	S	
Gas & Oil Products, Ltd., Hartell	2,500	*600	S-C	Dubbs
Gold Standard Oils, Ltd., Wainwright	300	.....	S-A	
Huff Ref. Co., Ltd., Lethbridge†	500	.....	S	
Imperial Oil, Ltd., Calgary	7,500	2,000	S-C-L-A	Tube & Tank
Lion Ref. Co., Calgary†	500	.....	S-A	
Munro, J. R., Hubalta	500	.....	S	
Okotoks Oil & Ref. Co., Ltd., Okotoks	300	.....	S	
Shaw Petroleums, Ref. Div., Lloydminster	300	.....	S-A	
Warner Oil Ref. & Dist. Co., Warner	500	.....	S	
Total	19,250	.....		
Estimated cracked gasoline capacity	.....	3,550		

*Raw-charge capacity. †Shut down.

BRITISH COLUMBIA

Home Oil Distributors, Ltd., N. Vancouver†	2,000	.....	S	
Imperial Oil, Ltd., Ioco	32,500	600	S-C-L-A	Tube & Tank
Shell Oil Co. of B. C., Shelburn	4,200	.....	S	
Standard Oil Co. of B. C., Ltd., Vancouver	4,700	.....	S	
Total	43,400			
Estimated cracked gasoline capacity	.....	600		

†Shut down.

MANITOBA

Anglo-Canadian Oils, Ltd., Brandon	1,400	*500	S-C-A	Dubbs
Carman Oil Ref., Ltd., Carman†	250	.....	S	
Mid-West Refineries, Ltd., Dauphin	200	.....	S	
North Star Oil, Ltd., Winnipeg	1,200	*500	S-C	Dubbs
Radio Oil Ref., Ltd., Winnipeg	700	.....	S	
Total	3,750			
Estimated cracked gasoline capacity	.....	500		

*Raw-charge capacity. †Shut down.

NEW BRUNSWICK

New Brunswick Gas & Oilfields, Ltd., Weldon	250	.....	S	

NORTHWEST TERRITORIES

Northwest Co., Ltd., Fort Norman	850	.....	S	

NOVA SCOTIA

Imperial Oil, Ltd., Halifax	32,500	3,400	S-C-A	Tube & Tank

ONTARIO

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery	Type of cracking plant
British American Oil Co., Ltd., Toronto	6,000	*3,000	S-C	Dubbs, Cross
Burlington Refineries, Ltd., Hamilton†	600	.....	S	
Canadian Oil Co., Ltd., Petrolia	4,000	*2,000	S-C-L-W	Dubbs
Good Rich Ref. Co., Ltd., Port Credit	4,000	*1,300	S-C	Dubbs
Imperial Oil, Ltd., Sarnia	41,000	10,350	Comp.	Tube & Tank
McColl-Frontenac Oil Co., Ltd., Toronto	12,000	*7,000	S-C	Gasoline Prod.
Total	67,600	.....		
Estimated cracked gasoline capacity	.....	17,000		

*Raw-charge capacity. †Shut down.

QUEBEC

British American Oil Co., Ltd., Montreal	12,000	7,500	S-C-A	Winkler-Koch
Gen. Pet. Refineries, Pointe-aux-Trembles	300	.....	S	
Imperial Oil, Ltd., Montreal	25,000	3,400	S-C-A	Tube & Tank
McColl-Frontenac Oil Co., Ltd., Montreal	20,000	*12,000	S-C	Gasoline Prod.
Shell Oil Co. of Canada, Ltd., Montreal	10,000	*5,500	S-C	Dubbs Comb.
Total	67,300	.....		
Estimated cracked gasoline capacity	.....	44,400		

*Raw-charge capacity.

SASKATCHEWAN

British American Oil Co., Ltd., Moose Jaw	4,000	2,000	S-C-A	Winkler-Koch
Consumers Co-Op. Ref., Regina	1,500	*500	S-C	Dubbs
Eston Ref. Co., Ltd., Eston	300	.....	S	
Hi-Way Refineries, Ltd., Moose Jaw	275	.....	S	
Hi-Way Refineries, Ltd., Saskatoon	275	.....	S	
Home Oil & Ref. Co., Ltd., Humboldt	400	.....	S	
Imperial Oil, Ltd., Regina	7,500	1,500	S-C-A	Tube & Tank
Northern Pet. Corp., Ltd., Kamsack	200	.....	S	
Sterling Ref., Ltd., Yorkton	1,000	.....	S	
Total	15,450			
Estimated cracked gasoline capacity	.....	3,750		

*Raw-charge capacity. †Shut down.

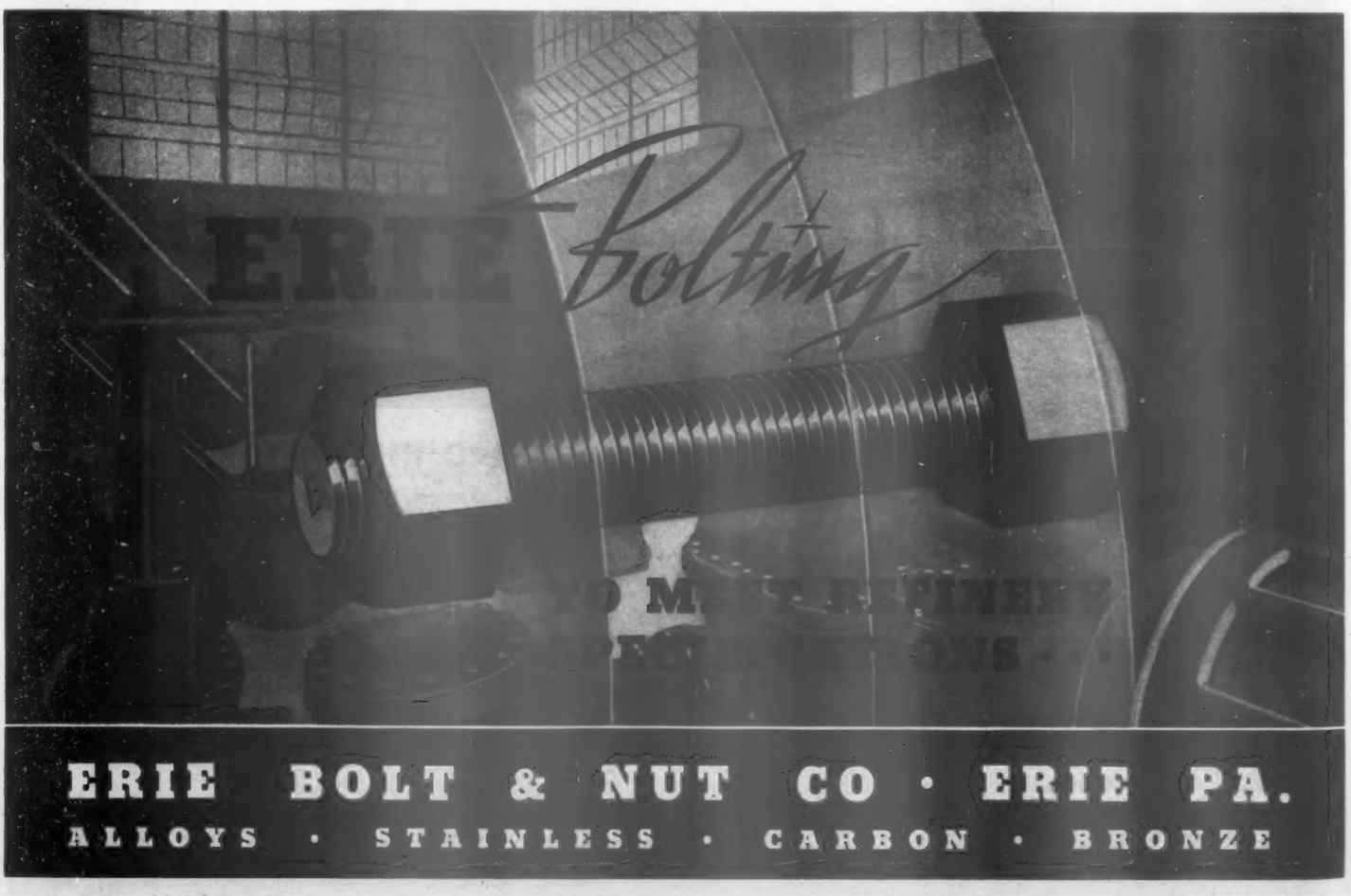
Shutdown Plants in United States

ARKANSAS

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery	Type of cracking plant
Cross Co., Henry H., Smackover	4,000	1,500	S-C-L-A	Donnelly

CALIFORNIA

Atlas Ref. Co., N. Long Beach	2,400	.....	S
Bush, R. R., Oil Co., Long Beach	1,500	.....	S
California Oil & Ref. Co., N. Long Beach	4,000	.....	S
Aromalene, Inc., Long Beach	3,000	.....	S
East-West Ref. Co., Los Angeles	3,200	.....	S



CALIFORNIA (Continued)

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery	Type of cracking plant
Envoy Pet. Co., Los Angeles	3,500	.....	S	
Estado Pet. Corp., Long Beach	9,000	.....	S	
General Pet. Corp. of Calif., Vernon†	28,000	.....	S	
Industrial Lubricants, Inc., Southgate	800	.....	S	
Interstate Oil Corp., Taft	250	.....	S	
Kern Oil Co., Ltd., Pico	4,000	.....	S	
Kolingo Ref. Co., Coalinga	300	.....	S-A	
McCallem Ref. Co., McCallem	4,000	.....	S	
New Santa Maria Ref. Co., Santa Maria	1,500	.....	S	
Olympic Ref. Co., Long Beach	6,500	.....	S	
Petco Ref. Co., Santa Maria	9,500	.....	S-A	
Richfield Oil Corp., Hynes	55,000	14,000	S-C	Cross
Richfield Oil Corp., Vinvale	10,000	3,600	S-C	Sinclair
Signal Hill Ref. Co., Long Beach	3,500	.....	S	
Solvents Ref. Co., Vinvale	750	.....	S	
Steiner, Walter, Ref. Co., Long Beach	2,000	.....	S	
Tracy Development Corp., Maricopa	1,200	.....	S	
Total	153,900	17,600		

†Lubricating-oil blending only.

ILLINOIS

Basin Oil Ref. Co., Centralia	2,000	.....	S	
Centralia Ref. Co., Centralia	2,000	.....	S	
Egyptian Prod. & Ref. Co., Centralia	2,000	.....	S	
Fairfield Ref. Corp., Fairfield	1,800	.....	S	
Goodson Oil Co., Inc., Sandoval	1,200	.....	S	
H. S. & B. Ref. Co., Mill Shoals	1,200	.....	S	
Total	10,200			

KANSAS

Krueger Oil & Ref. Co., Natoma	150	.....	S	
Roper Pet. Co., Parsons	750	.....	S	
Total	900			

LOUISIANA

Shoreline Oil Co., Shoreline	5,000	2,200	S-C	

MICHIGAN

Caro Refineries, Inc., Caro	1,000	.....	S	
Hi-Way Ref. Co., Vernon (Rosebud)	500	.....	S	
Mid-West Refineries, Inc., Grand Rapids	2,000	.....	S	
Mid-West Refineries, Inc., Dewey	1,500	.....	S	
Sovereign Ref. Co., Saginaw	1,200	.....	S	
Titan Ref. Co., Plymouth	4,000		S-A	
Trumbull Asphalt & Ref. Co., Alma	1,000		S-A	Vacuum
Total	11,200	.....		

MISSISSIPPI

Johnson, E. C., Co., Vicksburg	4,000	.....	S	

MONTANA

Bridger Refinery, Bridger	60	.....	S	
Carroll, L. Ray, Roundup	100	.....	S	
Deloraine Ref. Co., Ollmont	225	.....	S	
Gallop City Refinery, Conrad	60	.....	S	
Hannah-Porter Co., Sweet Grass	400	.....	S	
Home Oil & Ref. Co., Conrad	600	.....	S	
Lake County Refinery, Polson	100	.....	S	
Morton Ref. Co., Ollmont	200	.....	S	
Russell Oil Co., Billings†	1,000	.....	S	
Russell Oil Co., Butte†	500	.....	S	
Total	3,245			

†Leased by Independent Ref. Co.

NEW JERSEY

Seaboard Ref. Co., Piscataway	6,000	.....	S	

NEW MEXICO

Pecos Diamond Ref. Co., Inc., Artesia	325	.....	S	
San Juan Oil & Ref. Co., Farmington	400	.....	S	
Total	725			

OHIO

Panda Oil & Ref. Co., Toledo	3,500	.....	S-A	

OKLAHOMA

Cities Service Oil Co. (Del.), Okmulgee	4,000	600	S-C-L-W	Doherty
Eason Oil Co., Enid	5,000	.....	S	
Globe Oil & Ref. Co. (Okla.), Blackwell	8,000	4,000	S-C	Winkler-Koch
Knox Ref. Co., Covington	500	.....	S	
Omar Ref. Co., Garber	5,000	2,000	S-C	
Pilgrim, Inc., Kingston	50	.....	S-L	
Sun Oil Co., Yale	5,000	.....	S	
Total	27,550	6,600		

TENNESSEE

Russell Producing Co., Sunbright	150	.....	S	

TEXAS

Delta Ref. Co., Sullivan City	500	.....	S	
Danciger Oil & Ref. Co., Longview	6,500	.....	S-C	Dubbs
Howard County Ref. Co., Big Spring	2,000	.....	S	
McMurrey Ref. Co., Tyler	6,000	1,500	S-C	Dubbs
North Texas Ref. Co., Gainesville	600	.....	S	
Phoenix Ref. Co., Waco	1,500	.....	S	
Texas Ranger Oil Co., San Antonio	750	.....	S	
Tucker Oil Co., Burkburnett	250	.....	S	
Valley Ref. Co., Harlingen	1,000	.....	S	
Total	19,100	1,500		

UTAH

Baker Pet. Corp., Virgin†	200	.....	S	

†Leased from Diamond Oil Co.

WYOMING

Salt Creek Refinery, Columbine (Casper)	200	.....	S	
Upton Refinery, Upton	110	.....	S	
Whitman, A. J., Leroy	200	.....	S	
Total	510			

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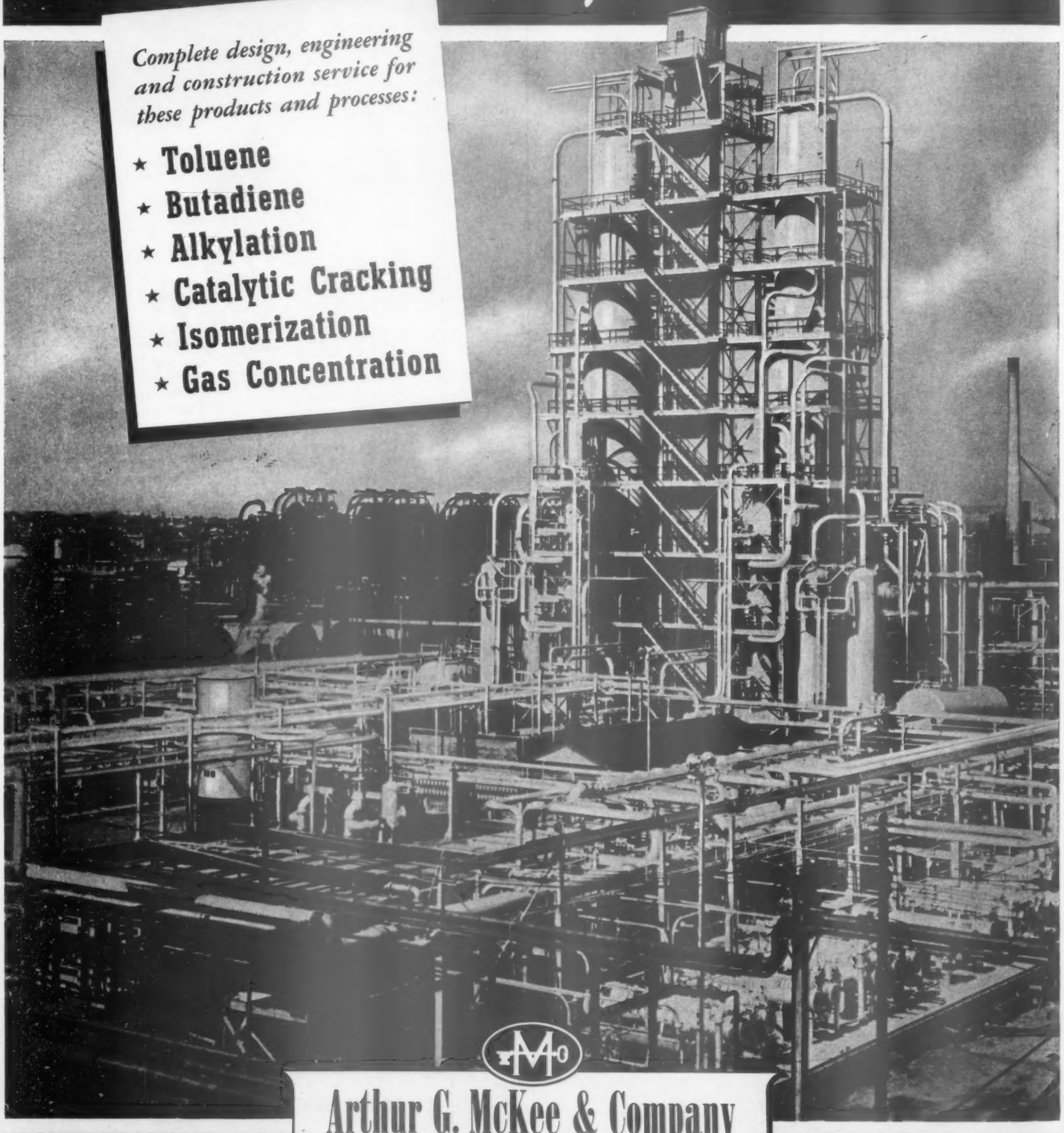

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BUYERS' GUIDE of REFINERY EQUIPMENT

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Abrasive Co., Tacony & Fraley Sts., Philadelphia, Pa.
American Abrasive Metals Co., Irvington, N. J.
American Optical Co., Southbridge, Mass.
Brunner & Lay, 727 S. Jefferson, Chicago, Ill.
Carborundum Co., Niagara Falls, N. Y.
Illinois Minerals Co., Cairo, Ill.
Norton Co., Worcester, Mass.
Osage Metal Co., Inc., Oklahoma City, Okla.
Pangborn Corp., Hagerstown, Md.
U. S. Rubber Co., 1230 Sixth Ave., New York City

ABSORBERS:

American Locomotive Co., Alco Products Div., 30 Church St., New York City
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Beaird Corp., J. B., Shreveport, La.
Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Braun, C. F., & Co., Inc., Alhambra, Calif.
Fluor Corp., Ltd., Box 7030, Los Angeles, Calif.
Foster Wheeler Corp., 6 Church St., New York City
Gasoline Plant Construction Co., Houston, Tex.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Hudson Engineering Co., Houston, Tex.
Lancaster Iron Works, Lancaster, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.
Meriam Co., The, Cleveland, Ohio
National Carbon Co., Inc., Cleveland, Ohio
National Tank Co., Tulsa, Okla.
Research & Development Corp., Wilmington, Del.
Stearns-Roger Manufacturing Co., Denver, Colo.
Struthers-Wells Co., Div. of Struthers Wells-Titusville Corp., Warren, Pa.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Turbo-Mixer Corp., The, 247 Park Ave., New York City
Vulcan Steel Tank Corp., Tulsa, Okla.
Watkins, Inc., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.

ABSORBERS—Ammonia:

Bethlehem Steel Co., Bethlehem, Pa.
Hendrick Mfg. Co., Carbondale, Pa.
Lancaster Iron Works, Lancaster, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.
Wyatt Metal & Boiler Works, Houston, Tex.

ACCUMULATORS—Steam:

Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Foster Wheeler Corp., 6 Church St., New York City
Hudson Engineering Co., Houston, Tex.
Kieley & Mueller, Inc., 40 W. 13th St., New York City
Lancaster Iron Works, Lancaster, Pa.
Watkins, Inc., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.

ACETYLENE:

Air Reduction Sales Co., 60 E. 42nd St., New York City
Linde Air Products Co., 30 E. 42nd St., New York City
Modern Engineering Co., St. Louis, Mo.
National Cylinder Gas Co., 205 W. Wacker, Chicago, Ill.

ACETYLENE GENERATORS:

Air Reduction Sales Co., 60 E. 42nd St., New York City
Linde Air Products Co., 30 E. 42nd St., New York City
Modern Engineering Co., St. Louis, Mo.
National Cylinder Gas Co., 205 W. Wacker, Chicago, Ill.
Sight Feed Generator Co., Richmond, Ind.

ACIDPROOF BRICK—See BRICK, Acidproof:

ACIDPROOF BRICK LININGS—See LININGS, Acidproof, Brick and Tile:

ACIDPROOF CEMENT—See CEMENT, Acidproof:

ACIDPROOF RECOVERY SYSTEMS—See PLANTS, Acid Recovery:

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American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York City
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Du Pont de Nemours, E. I., & Co., Inc., Wilmington, Del.
General Chemical Co., 40 Rector St., New York City
Monsanto Chemical Co., St. Louis, Mo.
New Jersey Zinc Co., 160 Front St., New York City
Ozark Chemical Co., Tulsa, Okla.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.

ACID-TREATING EQUIPMENT—See Specific Equipment:

ADSORBENTS:

Attapulgus Clay Co., 260 S. Broad St., Philadelphia, Pa.
Carbide & Carbon Chem. Corp., 30 E. 42nd St., New York City
West Virginia Pulp & Paper Co., 230 Park Ave., New York City

ADDITIVES:

Alox Corp., 70 Pine St., New York City
Petroleum Solvents Corp., 331 Madison Ave., New York City
Monsanto Chemical Co., St. Louis, Mo.

AFTER-COOLERS:

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Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio
Braun, C. F., & Co., Inc., Alhambra, Calif.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Bury Compressor Co., Erie, Pa.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Coy Co., Jos. A., Inc., Tulsa, Okla.
Devine, J. P., Mfg. Co., Mount Vernon, Ill.
Engineers & Fabricators, Inc., Houston, Tex.
Foster Wheeler Corp., 6 Church St., New York City
Griscom-Russell Co., The, 285 Madison Ave., New York City
Ingersoll-Rand Co., 11 Broadway, New York City
National Radiator Corp., Johnstown, Pa.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Struthers-Wells Co., Div. of Struthers Wells-Titusville Corp., Warren, Pa.
Sullivan Machinery Co., Michigan City, Ind.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Worthington Pump & Machinery Corp., Harrison, N. J.
Wyatt Metal & Boiler Works, Houston, Tex.

AGITATORS:

Alsop Engineering Co., Milldale, Conn.
Bethlehem Foundry & Machine Co., Bethlehem, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Blickman, S., Inc., Weehawken, N. J.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
Eastern Engr. Co., New Haven, Conn.
Frick Co., Waynesboro, Pa.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Graver Tank & Mfg. Co., 4809 Todd, East Chicago, Ind.
Haveg Corp., Newark, Del.
Hendrick Mfg. Co., Carbondale, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.
Mixing Equipment Co., Inc., Rochester, N. Y.
Morrison Brothers, Dubuque, Iowa
Muskegon Boiler Works, Muskegon, Mich.
New England Tank & Tower Co., Everett, Mass.
Oxley Engineering Co., Ltd., London, Eng.
Watkins, Inc., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.

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AIR COMPRESSORS—See COMPRESSORS, Air:

AIR FILTERS—See FILTERS, Air:

AIR EJECTORS—See EJECTORS, Air:

AIR MOTORS—See MOTORS, Air:

AIR TRAPS—See TRAPS, Air:

ALARMS—Combustible Gas:

Davis Emergency Equipment Co., Inc., Newark, N. J.
Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.

ALARMS, High and Low Water—See COLUMNS, Water, Safety Alarm:

ALKYLATION UNITS—See PROCESSES, Alkylation:

ALLOYS—Chrome and Chrome-Nickel:

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
American Manganese Steel Co., 389 E. 14th St., Chicago Heights, Ill.
Arcos Corp., 401 N. Broad St., Philadelphia, Pa.
Bethlehem Foundry & Machine Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Carpenter Steel Co., Reading, Pa.
Duraloy Co., The, Scottdale, Pa.
Duriron Co., The, Inc., Dayton, Ohio
Hadfields Limited, London, Eng.
International Nickel Co., 67 Wall St., New York City
Jorgenson, Earle M. Co., Houston, Tex.
Lebanon Steel Foundry, Lebanon, Pa.
Ohio Steel Foundry Co., The, Springfield, Ohio
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Standard Alloy Co., 1679 Collamer Rd., Cleveland, Ohio
Wood, Alan, Steel Co., Conshohocken, Pa.

ALLOYS—Copper:

American Brass Co., 25 Broadway, New York City
Ampco Metals, Inc., Milwaukee, Wis.
Beryllium Corp. of Pennsylvania, Reading, Pa.
Bunting Brass & Bronze Co., Toledo, Ohio
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Gilbert Brass Foundry Co., St. Louis, Mo.
Hadfields Limited, London, Eng.
Progressive Brass Mfg. Co., Tulsa, Okla.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Scovill Mfg. Co., Waterbury, Conn.
Shenango-Penn Mold Co., Dover, Ohio
Wheatley Brothers, Tulsa, Okla.
Wood, Alan, Steel Co., Conshohocken, Pa.

ALLOYS—Corrosion Resisting:

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Alloy Steel Products Co., Inc., Linden, N. J.
Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
American Brass Co., 25 Broadway, New York City
American Manganese Steel Co., 389 E. 14th St., Chicago Heights, Ill.
Ampco Metals, Inc., Milwaukee, Wis.
Bethlehem Foundry & Machine Co., Bethlehem, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Bunting Brass & Bronze Co., Toledo, Ohio
Burgess-Parr Co., Freeport, Ill.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Carpenter Steel Co., Reading, Pa.
Carson Cadillac Corp., Birmingham, Ala.
Copper Alloy Foundry Co., The, Elizabeth, N. J.
Duraloy Co., The, Scottdale, Pa.
Duriron Co., The, Inc., Dayton, Ohio
Hadfields Limited, London, Eng.
Haynes Stellite Co., Kokomo, Ind.
International Nickel Co., 67 Wall St., New York City
Jorgenson, Earle M. Co., Houston, Tex.
Lebanon Steel Foundry, Lebanon, Pa.
National Lead Co., 111 Broadway, New York City
Republic Steel Corp., Republic Bldg., Cleveland, Ohio
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Scovill Mfg. Co., Waterbury, Conn.
Shenango-Penn Mold Co., Dover, Ohio
Sivyer Steel Casting Co., Milwaukee, Wis.
Standard Alloy Co., 1679 Collamer Rd., Cleveland, Ohio
Wall-Colmonoy Corp., Buhl Bldg., Detroit, Mich.
Watkins, Inc., Wichita, Kans.
Weber Engine Works, Kansas City, Mo.
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

ALLOYS—Hard Surfacing:

Carnegie-Illinois Steel Corp., Carnegie Bldg., Pittsburgh, Pa.
Central Steel & Wire Co., 4545 S. Western Blvd., Chicago, Ill.
Chicago Steel & Wire Co., 103rd St. and Torrence Ave., Chicago, Ill.
Crucible Steel Co. of America, 405 Lexington Ave., New York City
Diamond Metal Co., Houston, Tex.
Fahralloy Co., The, 150th St. and Lexington Ave., Chicago, Ill.
Gulf Coast Machine & Supply Co., Beaumont, Tex.
Harnischfeger Corp., Milwaukee, Wis.
Haynes Stellite Co., Kokomo, Ind.
Jorgenson, Earle M., Co., 5311 Clinton Drive, Houston, Tex.
Linde Air Products Co., The, 30 E. 42nd St., New York City
Mills Alloys, Inc., 11320 S. Alameda St., Los Angeles, Calif.
National Cylinder Gas Co., 205 W. Wacker Drive, Chicago, Ill.
Osage Metal Co., Inc., Oklahoma City, Okla.
Republic Steel Corp., Cleveland, Ohio
Stoody Co., Whittier, Calif.
Youngstown Steel & Tube Co., Youngstown, Ohio

ALLOYS—Molybdenum:

American Manganese Steel Co., 389 E. 14th St., Chicago Heights, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Carpenter Steel Co., Reading, Pa.
Duraloy Co., The, Scottdale, Pa.
Hadfields Limited, London, Eng.
Jorgenson, Earle M. Co., Houston, Tex.
Lebanon Steel Foundry, Lebanon, Pa.
Molybdenum Corp. of America, Pittsburgh, Pa.
Ohio Steel Foundry Co., The, Springfield, Ohio
Republic Steel Corp., Republic Bldg., Cleveland, Ohio
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Standard Alloy Co., 1679 Collamer Rd., Cleveland, Ohio

ALLOYS—Nickel:

American Manganese Steel Co., 389 E. 14th St., Chicago Heights, Ill.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Carpenter Steel Co., Reading, Pa.
Copper Alloy Foundry Co., The, Elizabeth, N. J.
Duraloy Co., The, Scottdale, Pa.
Duriron Co., The, Inc., Dayton, Ohio
Hadfields Limited, London, Eng.
International Nickel Co., 67 Wall St., New York City
Jorgenson, Earle M. Co., Houston, Tex.
Ohio Steel Foundry Co., The, Springfield, Ohio
Republic Steel Corp., Republic Bldg., Cleveland, Ohio
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Scovill Mfg. Co., Waterbury, Conn.
Shenango-Penn Mold Co., Dover, Ohio
Wall-Colmonoy Corp., Buhl Bldg., Detroit, Mich.
Wood, Alan, Steel Co., Conshohocken, Pa.
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

AMMONIA COMPRESSORS—See COMPRESSORS, Ammonia:

AMMONIA:

Du Pont de Nemours, E. I., & Co., Inc., Wilmington, Del.
Mathieson Alkali Works, Inc., 60 E. 42nd St., New York City
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.

ANCHORS, Guy Line:

Bethlehem Steel Co., Bethlehem, Pa.
Chance, A. B., Co., The, Centralia, Mo.
Copperweld Steel Co., Glassport, Pa.
Dillon, W. C., & Co., Inc., 5410 W. Harrison, Chicago, Ill.
Everstick Anchor Co., Fairfield, Iowa
Grip-Tite Mfg. Co., Winterset, Iowa
Kearney, James R., Corp., St. Louis, Mo.
Mastergrip Utilities Supply Corp., St. Louis, Mo.
Oliver Iron & Steel Corp., 1001 Muriel St., Pittsburgh, Pa.
Texas Creosoting Co., Orange, Tex.

ARCHES—Furnace:

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Bigelow-Liptak Corp., 2842 W. Grand Blvd., Detroit, Mich.
Detrick, M. H., Co., 140 S. Dearborn, Chicago, Ill.
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
Kellogg Co., M. W., 225 Broadway, New York City
LaClede Christy Clay Products Co., St. Louis, Mo.
McLeod & Henry Co., Troy, N. Y.
Mexico Refractories Co., Mexico, Mo.
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Ryerson, Jos., T., & Sons, 2558 W. 16th St., Chicago, Ill.

ARCHES—Suspended:

Armstrong Cork Products Co., Lancaster, Pa.
Bigelow-Liptak Corp., 2842 W. Grand Blvd., Detroit, Mich.
Detrick, M. H., Co., 140 S. Dearborn, Chicago, Ill.
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
Kellogg Co., M. W., 225 Broadway, New York City
LaClede Christy Clay Products Co., St. Louis, Mo.
McLeod & Henry Co., Troy, N. Y.
Mexico Refractories Co., Mexico, Mo.
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.

AROMATIZATION—See PROCESSES, Refining

ARRESTERS—Spark, Engine Exhaust:

Air-Maze Corp., 5200 Harvard Ave., Cleveland, Ohio
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Burgess Battery Co., Acoustic Div., 2823-J W. Roscoe St., Chicago, Ill.
Engineering Specialties Co., 39 Cortlandt St., New York City

ARRESTERS—Flame, Tank:

Air-Maze Corp., 5200 Harvard Ave., Cleveland, Ohio
Johnson & Jennings, 877 Addison Rd., Cleveland, Ohio
Morrison Brothers, Dubuque, Iowa
Shand & Jurs Co., Berkeley, Calif.
Staytite Co., The, Houston, Tex.
Tokheim Co., Cedar Rapids, Iowa

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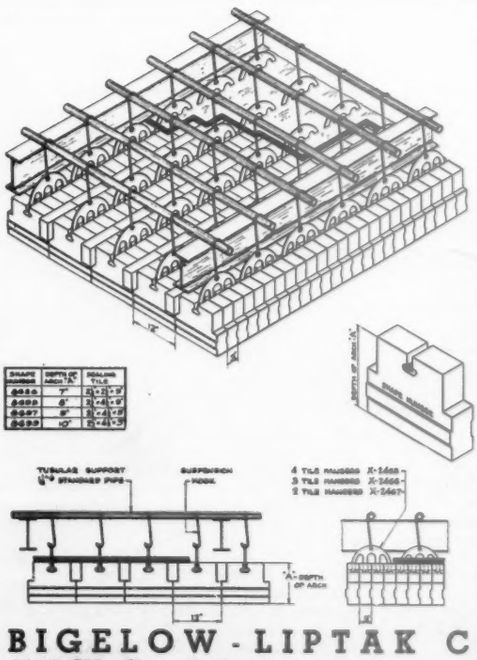

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General Electric Co., Schenectady, N. Y.
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Kellogg Switchboard & Supply Co., 6650 S. Cicero, Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ASBESTOS—Corrugated:
Asbestos & Engineering Products, Ltd., Winchester House, London, Eng.
Carey, Philip, Co., The, Cincinnati, Ohio
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Mattison Co., Ambler, Pa.
Ruberoid Co., 500 Fifth Ave., New York City
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Standco Bolt Co., Houston, Tex.
Union Asbestos & Rubber Co., Cicero, Ill.

ASBESTOS CLOTHING—See CLOTHING, Asbestos:

ASBESTOS INSULATION—See INSULATION, Asbestos:

ASBESTOS PACKING—See PACKING, Asbestos:

ASPHALT PLANTS—See PROCESSES, Refinery:

ATMOSPHERIC CONDENSERS—See CONDENSERS, Atmospheric:

AUTOMATIC CONTROLLERS—See CONTROLLERS, Automatic:

AUTOCLAVES:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees, Eng.
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Badger, E. B., & Sons Co., 1608 Walnut St., Philadelphia, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Blickman, S., Inc., Weehawken, N. J.
Biggs Boiler Works, The, Akron, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Blaw-Knox Co., Blawnox, Pa.
Devine, J. P., Mfg. Co., Mount Vernon, Ill.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Hadfields Limited, London, Eng.
Hendrick Mfg. Co., Carbondale, Pa.
Kellogg Co., M. W., 225 Broadway, New York City
Lancaster Iron Works, Lancaster, Pa.
National Valve & Mfg. Co., 3101 Liberty Ave., Pittsburgh, Pa.
New England Tank & Tower Co., Everett, Mass.
Smith, A. O., Corp., Milwaukee, Wis.
Struthers-Wells Co., Div. of Struthers Wells-Titusville Corp., Warren, Pa.
Wyatt Metal & Boiler Works, Houston, Tex.

BACK PRESSURE VALVES—See VALVES, Back Pressure:

BACKING CLOTH, Wire—See CLOTH, Wire:

BAFFLE TILE—See TILE, Baffle:

BACK-PRESSURE REGULATORS — See REGULATORS, Back-Pressure:

BARGES:
American Bridge Co., Frick Bldg., Pittsburgh, Pa.
American Car & Foundry Co., 30 Church St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
Lancaster Iron Works, Lancaster, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.
Pennsylvania Shipyards, Inc., Beaumont, Tex.
Wyatt Metal & Boiler Works, Houston, Tex.

BARRELS—Steel:
American Can Co., 230 Park Ave., New York City
Brown Sheet Iron & Steel Co., St. Paul, Minn.
Columbian Steel Tank Co., Kansas City, Mo.
Continental Can Co., 100 E. 42nd St., New York City
Crown Can Co., Erie Ave. and H St., Philadelphia, Pa.
Meurer Steel Barrel Co., Jersey City, N. J.
National Enameling & Stamping Co., Granite City, Ill.
Petroleum Iron Works Co., Sharon, Pa.
Pressed Steel Tank Co., Milwaukee, Wis.
Wackman Welded Ware Co., St. Louis, Mo.
Wilson & Bennett Mfg. Co., 6532 S. Menard St., Chicago, Ill.

BAROMETRIC CONDENSERS—See CONDENSERS, Barometric:

BATH HOUSES—Steel, Portable—See HOUSES, Bath:

BATTERY-CHARGING EQUIPMENT:
American Automatic Electric Sales Co., 1033 W. Van Buren St., Chicago, Ill.
Cutler-Hammer, Inc., Milwaukee, Wis.
Electrical Facilities, Inc., Oakland, Calif.
Fansteel Metallurgical Corp., North Chicago, Ill.
General Electric Co. Schenectady, N. Y.
Good-All Electric Mfg. Co., Ogallala, Neb.
Hobart Brothers Co., Troy, Ohio
Kellogg Switchboard & Supply Co., 6650 S. Cicero, Chicago, Ill.
Sterling Machinery Corp., Kansas City, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Willard Storage Battery Co., E. 131st St. and St. Clair Ave., Cleveland, Ohio.

BAUXITE:
Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
Attapulgus Clay Co., 260 S. Broad St., Philadelphia, Pa.

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Floridin Co., Warren, Pa.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.

BELTS—Chain:
Baldwin-Duckworth Div., Chain Belt Co., Springfield, Mass.
Chain Belt Co., Milwaukee, Wis.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Emsco Derrick & Equipment Co., 6701 S. Alameda St., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio
Link Belt Co., 307 N. Michigan Ave., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Union Chain & Mfg. Co., Sandusky, Ohio
Whitney Chain & Mfg. Co., Hartford, Conn.

BEARING METAL:
Ampco Metal, Inc., Milwaukee, Wis.
Bunting Brass & Bronze Co., The, Toledo, Ohio
Dodge Mfg. Co., Mishawaka, Ind.
Eagle Picher Sales Co., The, Cincinnati, Ohio
Enardo Foundry & Mfg. Co., Tulsa, Okla.
Federal-Mogul Corp., 11031 Shoemaker St., Detroit, Mich.
Gilbert Brass Foundry Co., St. Louis, Mo.
Johnson Bronze Co., New Castle, Pa.
Magnolia Metal Co., Elizabeth, N. J.
National Lead Co., 111 Broadway, New York City
Revere Copper & Brass, Inc., 230 Park Ave., New York City
Shenango-Penn Mold Co., Dover, Ohio

BEARINGS—Antifriction:
Aetna Ball Bearing Co., 4600 Schubert Ave., Chicago, Ill.
Ahlberg Bearing Co., 3025 W. 47th St., Chicago, Ill.
Dodge Mfg. Co., Mishawaka, Ind.
Goodrich, B. F., Co., Akron, Ohio
Jeffrey Mfg. Co., The, Columbus, Ohio
Jones, W. A., Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago, Ill.
Link Belt Co., 307 N. Michigan Ave., Chicago, Ill.
Magnolia Metal Co., Elizabeth, N. J.
Medart Co., St. Louis, Mo.
Wood's, T. B., Sons Co., Chambersburg, Pa.

BEARINGS—Ball:
Aetna Ball Bearing Mfg. Co., 4612 Schubert Ave., Chicago, Ill.
Ahlberg Bearing Co., 3025 W. 47th St., Chicago, Ill.
Bantam Bearings Corp., South Bend, Ind.
Consolidated Bearings Co., Inc., East Orange, N. J.
Dodge Mfg. Corp., Mishawaka, Ind.
Fafnir Bearing Co., New Britain, Conn.
Gwilliam Co., 360 Furman St., Brooklyn, N. Y.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Link Belt Co., 307 N. Michigan Ave., Chicago, Ill.
McGill Mfg. Co., Valparaiso, Ind.
Marlin-Rockwell Corp., Jamestown, N. Y.
New Departure Div. (General Motors Corp.), Bristol, Conn.
Norma-Hoffman Bearings Corp., Stamford, Conn.
Shafer Bearing Corp., 35 E. Wacker Dr., Chicago, Ill.
S K F Industries, Inc., Front St. & Erie Ave., Philadelphia, Pa.
Torrington Co., The, Torrington, Conn.
Wood's, T. B., Sons Co., Chambersburg, Pa.

BEARINGS—Babbitted:
Bunting Brass & Bronze Co., Toledo, Ohio
Dick, R. and J., Inc., Passaic, N. J.
Dodge Mfg. Co., Mishawaka, Ind.
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Federal Mogul Corp., Shoemaker and Lillibridge Sts., Detroit, Mich.
Gilbert Brass Foundry Co., St. Louis, Mo.
Green Fuel Economizer Co., Inc., Beacon, N. Y.
Jones, W. A., Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago, Ill.
Johnson Bronze Co., New Castle, Pa.
Link Belt Co., 307 N. Michigan Ave., Chicago, Ill.
Magnolia Metal Co., Elizabeth, N. J.
Medart Co., St. Louis, Mo.
National Lead Co., 111 Broadway, New York City
Standard Pressed Steel Co., Stewart & Kenmore Sts., Philadelphia, Pa.
Wheatley Brothers, Tulsa, Okla.
Wood's, T. B., Sons Co., Chambersburg, Pa.

BEARINGS—Nonmetallic:
American Brakeblok Corp., Detroit, Mich.
Continental Diamond Fiber Co., Newark, Del.
Gatke Corp., 228 N. La Salle St., Chicago, Ill.
Richardson Co., The, Melrose Park, Ill.
Ryerson, Jos. T., & Sons, 16th and Rockwell Sts., Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

BEARINGS—Roller:
Aetna Ball Bearing Mfg. Co., 4612 Schubert Ave., Chicago, Ill.
Ahlberg Bearing Co., 3025 E. 47th St., Chicago, Ill.
American Roller Bearing Co., 416 Melwood Ave., Pittsburgh, Pa.
Bantam Bearings Corp., South Bend, Ind.
Bower Roller Bearing Co., 3040 Hart Ave., Detroit, Mich.
Fafnir Bearing Co., New Britain, Conn.
Consolidated Bearings Co., Inc., East Orange, N. J.
Dodge Mfg. Co., Mishawaka, Ind.
Gwilliam Co., 360 Furman St., Brooklyn, N. Y.
Hyatt Bearings Division (General Motors Sales Corp.), Harrison, N. J.
Link Belt Co., 307 N. Michigan Ave., Chicago, Ill.
McGill Mfg. Co., Valparaiso, Ind.
Medart Co., The, St. Louis, Mo.
Norma-Hoffman Bearings Corp., Stamford, Conn.
Orange Roller Bearing Co., Inc., Orange, N. J.
Roller Bearing Co. of America, Trenton, N. J.
Rollway Bearing Co., Ind., Syracuse, N. Y.
Shafer Bearing Corp., 35 E. Wacker Dr., Chicago, Ill.
S K F Industries, Inc., Front and Erie Ave., Philadelphia, Pa.
Tillson Bearings Corp., L'Anse, Mich.
Timken Roller Bearing Co., Canton, Ohio
Tyson Roller Bearing Corp., Massillon, Ohio
Wood's, T. B., Sons Co., Chambersburg, Pa.

BELTS—Conveyor:
Asbestos & Engineering Products, Ltd., London, Eng.
Audubon Wire Cloth Corp., Castor Ave., and Richmond St., Philadelphia, Pa.
British Belting & Asbestos, Ltd., Yorkshire, Eng.
Carlyle Rubber Co., 64 Park Place, New York City.
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Dick, R. and J., Co., Inc., Passaic, N. J.
Fuller Co., Catasauqua, Pa.
Goodall Rubber Co., 5 South 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Hewitt Rubber Corp., Buffalo, N. Y.
Imperial Belting Co., 1750 S. Kilbourn, Chicago, Ill.
Jeffrey Mfg. Co., The, Columbus, Ohio
Link Belt Co., 307 N. Michigan Ave., Chicago, Ill.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Manheim Mfg. & Belting Co., Manheim, Pa.
Quaker Rubber Corp., Philadelphia, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Rossendale-Ruboil Co., Newark, N. J.
Russell Manufacturing Co., Middletown, Conn.
Scandinavia Belting Co., Charlotte, N. C.
Standard Conveyor Co., St. Paul, Minn.
Thermoid Co., Trenton, N. J.
Ton-Tex Corp., Grand Rapids, Mich.
U. S. Rubber Co., 1230 Sixth Ave., New York City

BELTS—Endless Flat:
Asbestos & Engineering Products, Ltd., London, Eng.
Boston Woven Hose & Rubber Co., Cambridge, Mass.
British Belting & Asbestos, Ltd., Yorkshire, Eng.
Browning Manufacturing Co., Maysville, Ky.
Carlyle Rubber Co., 64 Park Place, New York City
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Dick, R. and J., Co., Inc., Passaic, N. J.
Gilmer, L. H., Co., Tacony, Philadelphia, Pa.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Hewitt Rubber Corp., Buffalo, N. Y.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Manheim Mfg. & Belting Co., Manheim, Pa.
Quaker Rubber Corp., Philadelphia, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Rhoads, J. E., & Sons, Philadelphia, Pa.
Rossendale-Ruboil Co., Newark, N. J.
Russell Manufacturing Co., Middletown, Conn.
Scandinavia Belting Co., Charlotte, N. C.
Schieren, Charles A., Co., 30 Ferry St., New York City
Thermoid Co., Trenton, N. J.
Ton-Tex Corp., Grand Rapids, Mich.
U. S. Rubber Co., 1230 Sixth Ave., New York City

BELTS—Folded Edge, Rubber Covered:
Asbestos & Engineering Products, Ltd., London, Eng.
Boston Woven Hose & Rubber Co., Cambridge, Mass.
Carlyle Rubber Co., 64 Park Place, New York City
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Garlock Packing Co., Palmyra, N. Y.
Gilmer, L. H., Co., Tacony, Philadelphia, Pa.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Hewitt Rubber Corp., Buffalo, N. Y.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
N. Y. Rubber Corp., 9 Rockefeller Plaza, New York City
Quaker Rubber Corp., Philadelphia, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Russell Mfg. Co., Middletown, Conn.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 Sixth Ave., New York City

BELTS—Leather:
Alexander Brothers, Inc., 405 N. Third St., Philadelphia, Pa.
Asbestos & Engineering Products, Ltd., London, Eng.
Chicago Belting Co., 125 N. Green, Chicago, Ill.
Davis Emergency Equipment Co., Inc., Newark, N. J.
Graton & Knight Mfg. Co., Worcester, Mass.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Houghton, E. F., Co., Third, American and Somerset Sts., Philadelphia, Pa.
Industrial Products Co., 2828 N. Fourth St., Philadelphia, Pa.
Rhoads, J. E., & Sons, 35 N. Sixth St., Philadelphia, Pa.
Schieren, Charles A., Co., 30 Ferry St., New York City
Strauss Co., 925 Liberty Ave., Pittsburgh, Pa.
Ton-Tex Corp., Grand Rapids, Mich.

BELTS—Multiple-V:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Asbestos & Engineering Products, Ltd., London, Eng.
Browning Mfg. Co., Maysville, Ky.
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Belting Co., 125 N. Green, Chicago, Ill.
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Dayton Rubber Mfg. Co., Dayton, Ohio
Dick, R. and J., Co., Inc., Passaic, N. J.
Gates Rubber Co., Denver, Colo.
Gilmer, L. H., Co., Tacony, Philadelphia, Pa.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Jones, W. A., Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago, Ill.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Manheim Mfg. & Belting Co., Manheim, Pa.
Medart Co., St. Louis, Mo.
Republic Rubber Co., The, Youngstown, Ohio
Rockwood Mfg. Co., Indianapolis, Ind.
British Belting & Asbestos, Ltd., Yorkshire, Eng.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 Sixth Ave., New York City
Wood's, T. B., Sons Co., Chambersburg, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

BELTS—Raw Edge, Rubber Covered:
Asbestos & Engineering Products, Ltd., London, Eng.
Boston Woven Hose & Rubber Co., Cambridge, Mass.
Carlyle Rubber Co., 64 Park Place, New York City
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Dayton Rubber Mfg. Co., Dayton, Ohio
Gilmer, L. H., Co., Tacony, Philadelphia, Pa.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Manheim Mfg. & Belting Co., Manheim, Pa.
N. Y. Rubber Corp., 9 Rockefeller Plaza, New York City
Republic Rubber Co., The, Youngstown, Ohio
Thermoid Co., Trenton, N. J.
Ton-Tex Corp., Grand Rapids, Mich.
U. S. Rubber Co., 1230 Sixth Ave., New York City

BELTS—Safety:
Balata, Victor, & Textile Belting Co., 53 Park Place, New York City
Boyer-Campbell Co., 6540 St. Antoine St., Detroit, Mich.
Bullard, E. D., Co., 275 Eighth St., San Francisco, Calif.
Davis Emergency Equipment Co., Inc., Newark, N. J.
Industrial Products Co., 2828 N. Fourth St., Philadelphia, Pa.
Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.
Pulmosan Safety Equipment Co., Brooklyn, N. Y.
Russell Mfg. Co., Middletown, Conn.
Strauss Co., 925 Liberty Ave., Pittsburgh, Pa.

BELT DRESSING—See DRESSING, Belt:

BELTS—Solid Woven, Cotton:
Asbestos & Engineering Products, Ltd., London, Eng.
Dick, R. and J., Co., Inc., Passaic, N. J.
Fenwick Mfg. Co., Newark, N. J.
Gilmer, L. H., Co, Tacony, Philadelphia, Pa.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Rhoads, J. E., & Sons, 35 N. Sixth St., Philadelphia, Pa.
Rossendale-Ruboil Co., Newark, N. J.
Russell Mfg. Co., Middletown, Conn.
Scandinavia Belting Co., Charlotte, N. C.
Stanley Belting Co., 15 N. Jefferson St., Chicago, Ill.
Strauss Co., 925 Liberty Ave., Pittsburgh, Pa.

BENCHES—Portable Work:
Blackhawk Mfg. Co., Milwaukee, Wis.
Martin, H. P., & Sons, Owensboro, Ky.
Standard Pressed Steel Co., Stewart and Kenmore Sts., Philadelphia, Pa.

BENDS—Pipe—See PIPE BENDS:

BENDS—Return:
Clow, James B., & Sons, 201 N. Talman, Chicago, Ill.
Hadfields Limited, London, Eng.
Key Co., East St. Louis, Ill.
Midwest Piping & Supply Co., St. Louis, Mo.
National Valve & Mfg. Co., 3101 Liberty Ave., Pittsburgh, Pa.
Ohio Steel Foundry Co., The, Springfield, Ohio
Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
Sivyer Steel Casting Co., Milwaukee, Wis.
Taylor Forge & Pipe Works, Chicago, Ill.
Thornhill-Craver Co., Houston, Tex.
Tube-Turns, Louisville, Ky.
U. S. Pipe & Foundry Co., Burlington, N. J.
Walworth Co., 60 E. 42nd St., New York City
Wyatt Metal & Boiler Works, Houston, Tex.

BELT IDLERS—See IDLERS, Belt:

BLEACHING EARTHS:
Attapulgus Clay Co., 260 S. Broad, Philadelphia, Pa.
Earthen Products, Inc., Houston, Tex.
Floridin Co., Warren, Pa.
Research & Development Corp., Wilmington, Del.

BLENDERS:
Blickman, S., Inc., Weehawken, N. J.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Hendrick Mfg. Co., Carbondale, Pa.
Mixing Equipment Co., Inc., Rochester, N. Y.
New England Tank & Tower Co., Everett, Mass.
%Proportioneers, Inc.%, Providence, R. I.
Turbo-Mixer Corp., The, 247 Park Ave., New York City
Wallace, Muller & Co., Ltd., 75 West St., New York City

BLINDS—Line:
Hamer Oil Tool Co., Long Beach, Calif.
Shand & Jurs Co., Berkeley, Calif.

BLOCKS—Hoisting:
Aeroil Burner Co., Inc., 561 Park Ave., West New York, N. J.
American Hoist & Derrick Co., St. Paul, Minn.
Chance, A. B., Co., The, Centralia, Mo.
Coffing Hoist Co., Danville, Ill.
Ford Chain Block Division of the American Chain & Cable Co., Inc., Second and Diamond Sts., Philadelphia, Pa.
Oil Well Supply Co., Dallas, Tex.
Sullivan Machinery Co., Michigan City, Ind.
Western Block Co., Lockport, N. Y.
Wheland Co., Chattanooga, Tenn.
Yale & Towne Mfg. Co., Frankfort, Philadelphia, Pa.

BLOWERS and EXHAUSTERS—Manhole:
Champion Blower & Forge Co., Lancaster, Pa.
Coppus Engineering Co., 344 Park Ave., New York City
South Bend Air Products, Inc., South Bend, Ind.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.

BLOWERS—Centrifugal:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Blower Corp., 6000 Russell Ave., Detroit, Mich.
Champion Blower & Forge Co., Lancaster, Pa.
Coppus Engineering Co., 344 Park Ave., New York City
DeLaval Steam Turbine Co., Trenton, N. J.
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., 165 Broadway, New York City
Furbio Co., Hermansville, Mich.
Good-All Electric Mfg. Co., Ogallala, Neb.
Green Fuel Economizer Co., Inc., Beacon, N. Y.
Homelite Corp., Port Chester, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City
Jeffrey Mfg. Co., The, Columbus, Ohio
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Roots Connersville Blower Co., Connersville, Ind.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.

BLOWERS—Steam Jet:
Champion Blower & Forge Co., Lancaster, Pa.
Elliott Co., Jeannette, Pa.
Haveg Corp., Newark, Del.
Inferno Co., Shreveport, La.

BLOWERS—Turbo:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Carling Turbine Blower Co., Worcester, Mass.
Coppus Engineering Co., 344 Park Ave., New York City
DeLaval Steam Turbine Co., Trenton, N. J.
Elliott Co., Jeannette, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

BOILER ARCHES and WALLS—See ARCHES or WALLS:

BOILER FEED-WATER REGULATORS—See REGULATORS, Boiler Feed-Water:

BOILER FUEL REGULATORS—See REGULATORS, Boiler Fuel:

BOILER TUBES—See TUBES, Boiler:

BOILER TUBE CLEANERS—See TUBE CLEANERS:

BOILERS—Steam:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Edge Moore Iron Works, Inc., 30 Rockefeller Plaza, New York City
Farrar & Trefts, Inc., Buffalo, N. Y.
Foster Wheeler Corp., 6 Church St., New York City
Kewanee Boiler Corp., Kewanee, Ill.
Lucey Boiler & Mfg. Co., Chattanooga, Tenn.
Oil Well Supply Co., Dallas, Tex.
Riley Stoker Corp., Worcester, Mass.
Union Iron Works, Erie, Pa.
Vogt, Henry, Machine Co., Louisville, Ky.
Wickes Boiler Co., Saginaw, Mich.

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Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Edge Moore Iron Works, Inc., 30 Rockefeller Plaza, New York City
Foster Wheeler Corp., 6 Church St., New York City
Riley Stoker Corp., Worcester, Mass.
Union Iron Works, Erie, Pa.
Vogt, Henry, Machine Co., Louisville, Ky.
Wickes Boiler Co., Saginaw, Mich.

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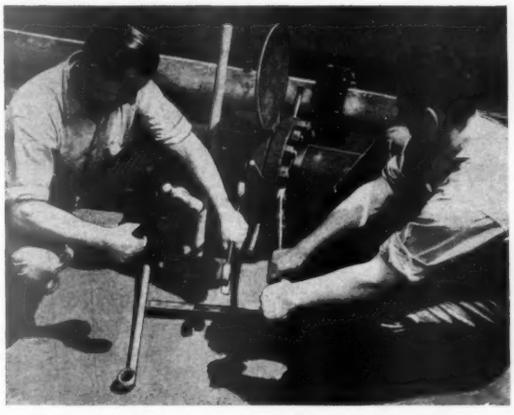

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Oliver Iron & Steel Corp., 1001 Muriel St., Pittsburgh Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Sheffield Steel Corp., Kansas City, Mo.
Standco Bolt Co., Houston, Tex.
Victor Products Corp., 2631 Belmont, Chicago, Ill.
Watkins, Inc., Wichita, Kans.

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Oliver Iron & Steel Corp., 1001 Muriel St., Pittsburgh, Pa.
Republic Steel Corp., Republic Bldg., Cleveland, Ohio
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago,Ill.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Sheffield Steel Corp., Kansas City, Mo.
Standco Bolt Co., Houston, Tex.
Victor Products Corp., 2631 Belmont, Chicago, Ill.

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Refinery Supply Co., Tulsa, Okla.
Shand & Jurs Co., Berkeley, Calif.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Vapor Recovery Systems Co., Compton, Calif.

BOOSTERS—Gas—See COMPRESSORS:

BOXES—Annealing:
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Biggs Boiler Works, The, Akron, Ohio
Blaw-Knox Co., Blawnox, Pa.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Ohio Steel Foundry Co., The, Springfield, Ohio

BOXES—Condenser:
Biggs Boiler Works, The, Akron, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
McNamar Boiler & Tank Co., Tulsa, Okla.
Mosher Steel Co., Houston, Tex.
Muskegon Boiler Works, Muskegon, Mich.
National Radiator Corp., Johnstown, Pa.
Oxley Engineering Co., Ltd., London, Eng.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vulcan Steel Tank Corp., Tulsa, Okla.
Watkins, Inc., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.

BOXES—Lock:
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Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Fischer & Porter Co., Hatboro, Pa.
National Airoil Burner Co., 1284 E. Sedgley Ave., Philadelphia, Pa.
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.

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Revere Copper & Brass, Inc., 230 Park Ave., New York City
Scovill Mfg. Co., Waterbury, Conn.

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BREATHERS—Tank—See VALVES, Tank Vent:

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General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Knight, Maurice A., Akron, Ohio
McLeod & Henry Co., Troy, N. Y.
National Carbon Co., Inc., Cleveland, Ohio
Quigley Co., Inc., 56 W. 45th St., New York City
U. S. Stoneware Co., The, 60 E. 42nd St., New York City

BRICK—Fire:
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Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Illinois Clay Products Co., Joliet, Ill.
Johns-Manville Corp., 22 E. 40th St., New York City
LaClede Christy Clay Products Co., St. Louis, Mo.
McLeod & Henry Co., Troy, N. Y.
Mexico Refractories Co., Mexico, Mo.
Norton Co., Worcester, Mass.
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Quigley Co., Inc., 56 W. 45th St., New York City
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BRICK—Fire Plastic:
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General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Illinois Clay Products Co., Joliet, Ill.
Johns-Manville Corp., 22 E. 40th St., New York City
Kellogg Co., M. W., Broadway, New York City
LaClede Christy Clay Products Co., St. Louis, Mo.
McLeod & Henry Co., Troy, N. Y.
Mexico Refractories Co., Mexico, Mo.
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Babcock & Wilcox Co., The, 85 Liberty St., New York City
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
Carborundum Co., Niagara Falls, N. Y.
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Illinois Clay Products Co., Joliet, Ill.
Johns-Manville Corp., 22 E. 40th St., New York City

Kellogg Co., M. W., 225 Broadway, New York City
LaClede Christy Clay Products Co., St. Louis, Mo.
McLeod & Henry Co., Troy, N. Y.
Mexico Refractories Co., Mexico, Mo.
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Quigley Co., Inc., 56 W. 45th St., New York City
Refractory & Insulation Corp., 381 Fourth Ave., New York City
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Carborundum Co., Niagara Falls, N. Y.
Corhart Refractories Co., 16th and Lee Sts., Louisville, Ky.
Custodis Construction Co., Inc., 80 Broad St., New York City
General Refractories Co., Philadelphia, Pa.
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BUBBLE CAPS—See CAPS, Bubble:

BUBBLE TRAYS—See TRAYS, Bubble:

BUBBLE TOWERS—See TOWERS, Bubble:

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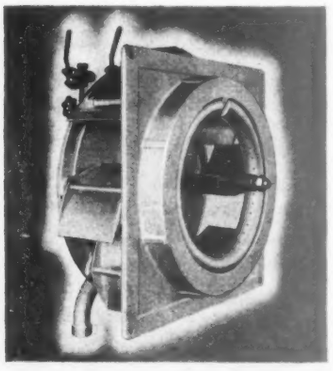

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Todd Combustion Equipment, Inc., 601 W. 26th St., New York City
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Pressed Steel Co., The, Wilkes-Barre, Pa.
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CAPS, Welding—See FITTINGS, Welding:

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Michiana Products Corp., Michigan City, Ind.
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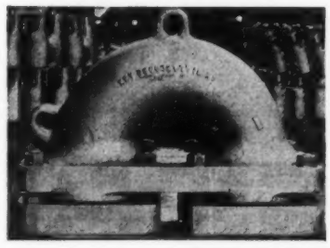

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Aluminum Industries, Inc., Cincinnati, Ohio
American Manganese Steel Co., 389 E. 14th St., Chicago Heights, Ill.
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Blaw-Knox Co., Blawnox, Pa.
Bunting Brass & Bronze Co., Toledo, Ohio
Burgess-Parr Co., Freeport, Ill.
Calorizing Co., The, Wilkinsburg Sta., Pittsburgh, Pa.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Copper Alloy Foundry Co., The, Elizabeth, N. J.
Driver Harris Co., Harrison, N. J.
Duraloy Co., The, Scottdale, Pa.
Farrel-Birmingham Co., Inc., Buffalo, N. Y.
Frederick Iron & Steel Co., Frederick, Md.
Goslin Birmingham Mfg. Co., Inc., 350 Madison Ave., New York City
Hadfields Limited, London, Eng.
Jeffrey Mfg. Co., The, Columbus, Ohio
Key Co., East St. Louis, Ill.
Lebanon Steel Foundry, Lebanon, Pa.
Link Belt Co., 307 N. Michigan Ave., Chicago, Ill.
Meehanite Metals Corp., 311 Ross St., Pittsburgh, Pa.
Michiana Products Corp., Michigan City, Ind.
Ohio Steel Foundry Co., The, Springfield, Ohio
Sivyer Steel Casting Co., Milwaukee, Wis.
St. Louis Steel Castings Co., St. Louis, Mo.
Wall-Colmonoy Corp., Buhl Bldg., Detroit, Mich.
Weber Engine Works, Kansas City, Mo.

CAST-IRON PIPE—See PIPE, Cast Iron:

CATALYTIC MEDIUMS:
Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
Attapulgus Clay Co., 260 S. Broad St., Philadelphia, Pa.
Carborundum Co., Niagara Falls, N. Y.
Davison Chemical Corp., The, Silica Gel Dept., 20 Hopkins Place, Baltimore, Md.
Dicalite Co., The, 120 Wall St., New York City
Filtrol Corp., 315 W. Fifth St., Los Angeles, Calif.
Philadelphia Quartz Co., 121 S. Third St., Philadelphia, Pa.
Research & Development Corp., Wilmington, Del.
Universal Oil Products Co., 316 S. Michigan Ave., Chicago, Ill.

CAUSTIC SODA:
American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York City
Diamond Alkali Co., Kippers Bldg., Pittsburgh, Pa.
Dow Chemical Co., The, Midland, Mich.
Mathieson Alkali Works, Inc., 60 E. 42nd St., New York City
Michigan Alkali Co., 1117 Ford Bldg., Detroit, Mich.
Monsanto Chemical Co., St. Louis, Mo.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.

CEMENT—Acidproof:
Baldwin-Hill Co., Trenton, N. J.
Chemical Construction Corp., 30 Rockefeller Plaza, New York City
Continental-Diamond Fibre Co., Bridgeport, Pa.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Haveg Corp., Newark, Del.
Keystone Refractories Corp., 120 Liberty St., New York City
Knight, Maurice A., Akron, Ohio
Lucas, Robert M., Co., 1955 W. 31st St., Chicago, Ill.
National Carbon Co., Inc., Cleveland, Ohio
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Quigley Co., Inc., 56 W. 45th St., New York City
Self-Vulcanizing Rubber Co., 605 W. Washington, Chicago, Ill.
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., The, 60 E. 42nd St., New York City
Utica Hydraulic Cement Co., Utica, Ill.

CEMENT—Corrosion Resistant:
Atlas Lumnite Cement Co., 135 E. 42nd St., New York City
Barrett Co., The, 40 Rector St., New York City
Baldwin-Hill Co., Trenton, N. J.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Haveg Corp., Newark, Del.
Kellogg Co., M. W., 225 Broadway, New York City
Lucas, Robert M., Co., 1955 W. 31st St., Chicago, Ill.
National Carbon Co., Inc., Cleveland, Ohio
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Self-Vulcanizing Rubber Co., 605 W. Washington, Chicago, Ill.
Tank Seal Products Co., Tulsa, Okla.
U. S. Stoneware Co., The, 60 E. 42nd St., New York City
Utica Hydraulic Cement Co., Utica, Ill.

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Baldwin-Hill Co., Trenton, N. J.
Carey, Philip Co., The, Cincinnati, Ohio
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Mattison Co., Ambler, Pa.
Kellogg Co., M. W., 225 Broadway, New York City
LaClede Christy Clay Products Co., St. Louis, Mo.
Lucas, Robert M., Co., 1955 W. 31st St., Chicago, Ill.
Mexico Refractories Co., Mexico, Mo.
Quigley Co., Inc., 56 W. 45th St., New York City
Refractory & Insulation Corp., 381 Fourth Ave., New York City
Schundler, F. E., Co., Joliet, Ill.
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., The, 60 E. 42nd St., New York City
Utica Hydraulic Cement Co., Utica, Ill.

CEMENT—Insulating:
Armstrong Cork Products Co., Lancaster, Pa.
Baldwin-Hill Co., Trenton, N. J.
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
Carborundum Co., Niagara Falls, N. Y.
Carey, Philip, Co., The, Cincinnati, Ohio
Dicalite Co., The, 120 Wall St., New York City
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Forty Eight Insulations, Inc., North Aurora, Ill.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Mattison Co., Ambler, Pa.
Kellogg Co., M. W., 225 Broadway, New York City
Lucas, Robert M., Co., 1955 W. 31st St., Chicago, Ill.
McLeod & Henry Co., Troy, N. Y.
Mexico Refractories Co., Mexico, Mo.
Owens Corning Fiberglas Corp., Toledo, Ohio
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Refractory & Insulation Corp., 381 Fourth Ave., New York City
Ruberoid Co., 500 Fifth Ave., New York City
Schundler, F. E., Co., Joliet, Ill.
Sullivan Co., The, Memphis, Tenn.
Universal Zonolite Insulation Co., 135 S. La Salle, Chicago, Ill.
Utica Hydraulic Cement Co., Utica, Ill.
Wyodak Chemical Co., 4600 E. 71st St., Cleveland, Ohio

CEMENT—Pipe-Joint:
X-Pando Corp., Long Island City, N. Y.

CEMENT—Portland:
Arkansas Portland Cement Co., Little Rock, Ark.
Ash Grove Lime & Portland Cement Co., Kansas City, Mo.
Atlas Lumnite Cement Co., Chrysler Bldg., New York City
Dewey Portland Cement Co., Kansas City, Mo.
Gulf Portland Cement Co., Houston, Tex.
Ideal Cement Co., Denver Colo.
Lehigh Portland Cement Co., Allentown, Pa.
Lone Star Cement Corp., Dallas, Tex.
Longhorn Portland Cement Co., San Antonio, Tex.
Marquette Cement Mfg. Co., 140 S. Dearborn, Chicago, Ill.
Missouri Portland Cement Co., St. Louis, Mo.
Monarch Cement Co., Humbolt, Kans.
Nebraska Cement Co., Omaha, Neb.
Oklahoma Portland Cement Co., Oklahoma City, Okla.
Pacific Portland Cement Co., San Francisco, Calif.
San Antonio Portland Cement Co., San Antonio, Tex.
Southwest Portland Cement Co., Los Angeles, Calif.
Trinity Portland Cement Co., Dallas, Tex.
Universal Atlas Cement Co., Waco, Tex.
Utica Hydraulic Cement Co., Utica, Ill.

CEMENT—Refractory:
Armstrong Cork Products Co., Lancaster, Pa.
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
Carborundum Co., Niagara Falls, N. Y.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Kellogg Co., M. W., 225 Broadway, New York City
Keystone Refractories Corp., 120 Liberty St., New York City
LaClede Christy Clay Products Co., St. Louis, Mo.
McLeod & Henry Co., Troy, N. Y.
Mexico Refractories Co., Mexico, Mo.
Norton Co., Worcester, Mass.
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Quigley Co., Inc., 56 W. 45th St., New York City
Refractory & Insulation Corp., 381 Fourth Ave., New York City
Ruberoid Co., 500 Fifth Ave., New York City
Schundler, F. E., Co., Joliet, Ill.
Southern Refractories Co., Fort Payne, Ala.
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., The, 60 E. 42nd St., New York City

CENTRIFUGAL BLOWERS—See BLOWERS, Centrifugal:

CENTRIFUGALS—Dewaxing:
Beach-Russ Co., 50 Church St., New York City
National Acme Co., 170 E. 131st St., Cleveland, Ohio
Sharples Corp., 23rd and Westmoreland Sts., Philadelphia, Pa.

CENTRIFUGAL PUMPS—See PUMPS, Centrifugal:

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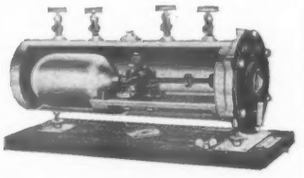

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Precision Scientific Co., 1750 N. Springfield Ave., Chicago, Ill.
Schaar & Co., 754 W. Lexington, Chicago, Ill.
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Walker, W. L., Co., Tulsa, Okla.

CHAIN HOISTS—See HOISTS, Chain:

CHEMICAL-MIXING EQUIPMENT—See MIXERS:

CHAINS—Silent:
Chain Belt Co., Milwaukee, Wis.
Link Belt Co., 307 N. Michigan Ave., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Union Chain & Mfg. Co., The, Sandusky, Ohio
Whitney Chain & Manufacturing Co., Hartford, Conn.

CHAINS—Transmission:
American Chain & Cable Co., Inc., York, Pa.
Baldwin-Duckworth Div., Springfield, Mass.
Chain Belt Co., Milwaukee, Wis.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Emsco Derrick & Equipment Co., Los Angeles, Calif
Jeffrey Mfg. Co., The, Columbus, Ohio
Link Belt Co., 307 N. Michigan Ave., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
National Supply Co., Toledo, Ohio
Union Chain & Mfg. Co., The, Sandusky, Ohio
Whitney Chain & Manufacturing Co., Hartford, Conn.

CHARTS—Recording:
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Brown Instrument Div., Minneapolis-Honeywell Regulator Co., Wayne and Windrum Aves., Philadelphia, Pa.
Foxboro Co., The, Foxboro, Mass.
Neumann Brothers, 150 Lafayette, New York City

CHILLERS, Oil—See CHILLING MACHINES

CHEMICAL-CONTROL EQUIPMENT:
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Elgin Softener Corp., Elgin, Ill.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Greiner, Emil, Co., 55 Van Dam St., New York City
Haering, D. W., & Co., 205 W. Wacker Drive, Chicago, Ill.
Jeffrey Mfg. Co., The, Columbus, Ohio
Pfoltz & Bauer, Inc., Empire State Bldg., New York City
%Proportioneers, Inc.%, Providence, R. I.
Tagliabue, C. J., Mfg. Co., Park Ave and Nostrand Ave., Brooklyn, N. Y.
Wallace & Tiernan Co., Belleville, N. J.

CHEMICALS—Refinery:
American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York City
Bay Chemical Co., 1048 Constance St., New Orleans, La.
Bird Archer Co., 2030 N. Natchez Ave., Chicago, Ill.
Carbide & Carbon Chemicals Corp., 30 E. 42nd St., New York City
Diamond Alkali Co., Kippers Bldg., Pittsburgh, Pa.
Dow Chemical Co., The, Midland, Mich.
Du Pont de Nemours, E. I., & Co., Inc., Wilmington, Del.
General Chemical Co., 40 Rector St., New York City
Hercules Powder Co., Inc., Wilmington, Del.
Hooker Electrochemical Co., Niagara Falls, N. Y.
Innes, Speiden & Co., 117 Liberty St., New York City
Lubri-Gas Laboratories, 221 N. La Salle, Chicago, Ill.
Mathieson Alkali Works, Inc., 60 E. 42nd St., New York City
Michigan Alkali Co., 1117 Ford Bldg., Detroit, Mich.
Molybdenum Corp. of America, Pittsburgh, Pa.
Monsanto Chemical Co., St. Louis, Mo.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Pfloltz & Bauer, Inc., Empire State Bldg., New York City
Reilly Tar & Chemical Co., Indianapolis, Ind.
Solvay Sales Corp., 40 Rector St., New York City
Sullivan Co., The, Memphis, Tenn.
Vanderbilt, R. T., Co., Inc., 230 Park Ave., New York City

CHEMICALS—Scale-Removing:
American Chemical Paint Co., Ambler, Pa.
American Sand-Banum Co., 9 Rockefeller Plaza, New York City
Bird Archer Co., 2030 N. Natchez Ave., Chicago, Ill.
Consolidated Chemical Industries, Houston, Tex.
Creative Chemical Co., 4618 Friendship Ave., Pittsburgh, Pa.
Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, Ill.
Du Pont de Nemours, E. I., & Co., Inc., Wilmington, Del.
Elgin Softener Corp., Elgin, Ill.
Feedwaters, Inc., 140 Cedar St., New York City
General Chemical Co., 40 Rector St., New York City
Hagan Corp., 300 Ross St., Pittsburgh, Pa.
Magnus Chemical Co., Garwood, N. J.
Monsanto Chemical Co., St. Louis, Mo.
National Aluminate Corp., 6216 W. 66th Place, Chicago, Ill.
Oakite Products, Inc., 22 Thames St., New York City
Philadelphia Quartz Co., 121 S. Third St., Philadelphia, Pa.
Protective Coatings, Inc., 10391 Northlawn, Detroit, Mich.
Sullivan Co., The, Memphis, Tenn.

CHEMICALS—Water-Treating:
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Betz, W. H. and L. D., Frankford, Philadelphia, Pa.
Bird Archer Co., 2030 N. Natchez Ave., Chicago, Ill.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Consolidated Chemical Industries, Houston, Tex.
Creative Chemical Co., 4618 Friendship Ave., Pittsburgh, Pa.
Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, Ill.
Diamond Alkali Co., Kippers Bldg., Pittsburgh, Pa.
Dow Chemical Co., The, Midland, Mich.
Du Pont de Nemours, E. I., & Co., Inc., Wilmington, Del.
Elgin Softener Corp., Elgin, Ill.
Feedwaters, Inc., 140 Cedar St., New York City
General Chemical Co., 40 Rector St., New York City
Haering, D. W., & Co., 205 W. Wacker Drive, Chicago, Ill.
Hagan Corp., 300 Ross St., Pittsburgh, Pa.
Horn, A. C., Co., Houston, Tex.
Mathieson Alkali Works, Inc., 60 E. 42nd St., New York City
Monsanto Chemical Co., St. Louis, Mo.
National Aluminate Corp., 6216 W. 66th Place, Chicago, Ill.
Oakite Products, Inc., 22 Thames St., New York City
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
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Sullivan Co., The, Memphis, Tenn.
Westvaco Chlorine Products Corp., 135 E. 42nd St., New York City

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Vogt, Henry, Machine Co., Louisville, Ky.
Worthington Pump & Machinery Corp., Harrison, N. J.

CHIMNEYS, Steel—See STACKS, Steel

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%Proportioneers, Inc.%, Providence, R. I.
Roy, Milton, Pumps, 1300 E. Mermaid Ave., Philadelphia, Pa.
Wallace & Tiernan Co., Belleville, N. J.

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Du Pont de Nemours, E. I., & Co., Inc., Wilmington, Del.
Hooker Electrochemical Co., Niagara Falls, N. Y.
Mathieson Alkali Works, Inc., 60 E. 42nd St., New York City
Michigan Alkali Co., 1117 Ford Bldg., Detroit, Mich.
Monsanto Chemical Co., St. Louis, Mo.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Westvaco Chlorine Products Corp., 135 E. 42nd St., New York City

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Cutler-Hammer, Inc., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Heinemann Circuit Breaker Co., Trenton, N. J.
Kearney, James R., Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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Dresser Mfg. Co., Bradford, Pa.
Skinner, M. B., Co., South Bend, Ind.
Wheatley Brothers, Tulsa, Okla.

CLAMPS—Pipe-Joint:
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Dresser Mfg. Co., Bradford, Pa.
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Gustin-Bacon Mfg. Co., Kansas City, Mo.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Skinner, M. B., Co., South Bend, Ind.
Smooth-On Mfg. Co., Jersey City, N. J.
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

CLAMPS—Pipe-Repair:
Clow, James B., & Sons, 201 N. Talman, Chicago, Ill.
Dresser Mfg. Co., Bradford, Pa.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Jarecki Mfg. Co., St. Louis, Mo.
Manufactured Specialties Co., 1252 Voskamp St., Pittsburgh, Pa.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa.
Skinner, M. B., Co., South Bend, Ind.
Smooth-On Manufacturing Co., Jersey City, N. J.
Stearns-Roger Manufacturing Co., Denver, Colo.
Wheatley Brothers, Tulsa, Okla.
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Jarecki Mfg. Co., St. Louis, Mo.
Mueller Co., Decatur, Ill.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Skinner, M. B., Co., South Bend, Ind.
Wheatley Brothers, Tulsa, Okla.

CLAMPS—Weld-Leak:
Dresser Mfg. Co., Bradford, Pa.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Skinner, M. B., Co., South Bend, Ind.
Wheatley Brothers, Tulsa, Okla.

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Filtrol Corp., 315 W. Fifth St., Los Angeles, Calif.
Floridin Co., Warren, Pa.
Opper, F. H., Inc., Savannah, Ga.
Research & Development Corp., Wilmington, Del.
Southern Refractories Co., Fort Payne, Ala.

CLAY—Contact:
Attapulgus Clay Co., 260 S. Broad St., Philadelphia, Pa.
Earthen Products, Inc., Houston, Tex.
Filtrol Corp., 315 W. Fifth St., Los Angeles, Calif.
Floridin Co., Warren, Pa.
Illinois Minerals Co., Cairo, Ill.
Miller, Max B., & Co., Inc., 501 Fifth Ave., New York City
Opper, F. H., Inc., Savannah, Ga.
Research & Development Corp., Wilmington, Del.

CLAY—Fire:
General Refractories Co., Philadelphia, Pa.
Green, A. P., Fire Brick Co., Mexico, Mo.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
Illinois Clay Products Co., Joliet, Ill.
LaClede-Christy Clay Products Co., St. Louis, Mo.
Mexico Refractories Co., Mexico, Mo.

CLAY TREATING—See PROCESSES, Clay Treating:

CLAYS—Percolating:
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Earthen Products, Inc., Houston, Tex.
Floridin Co., Warren, Pa.
Miller, Max B., & Co., Inc., 501 Fifth Ave., New York City
Opper, F. H., Inc., Savannah, Ga.

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CLEANERS—Gas—See SCRUBBERS, Gas:

CLEANERS—Heat-Exchangers:
Airetool Mfg. Co., Springfield, Ohio
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Magnus Chemical Co., Garwood, N. J.
Pilley Brush Co., Fort Madison, Iowa
Thomas C. Wilson, Inc., Long Island City, N. Y.

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Airetool Mfg. Co., Springfield, Ohio
Braun, C. F., & Co., Inc., Alhambra, Calif.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Elliott Co., Jeannette, Pa.
Jarecki Mfg. Co., St. Louis, Mo.
Magnus Chemical Co., Garwood, N. J.
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Oakite Products, Inc., 22 Thames St., New York City
Roto Co., Newark, N. J.
Wilson, Thomas C., Inc., 4728 37th St., Long Island City, N. Y.

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Airetool Mfg. Co., Springfield, Ohio
Elliott Co., Jeannette, Pa.
Homestead Valve Mfg. Co., Coraopolis, Pa.
Pilley Brush Co., Fort Madison, Iowa
Roto Co., The, Newark, N. J.
Wilson, Thomas Co., Inc., Long Island City, N. Y.

CLEANING COMPOUNDS:
American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York City
Columbia Alkali Corp., 30 Rockefeller Plaza, New York City
Dearborn Chemical Co., Chicago, Ill.
Diamond Alkali Co., Pittsburgh, Pa.
Homestead Valve Mfg. Co., Coraopolis, Pa., Box 18
Magnus Chemical Co., Garwood, N. J.
Mathieson Alkali Works, Inc., 60 E. 42nd St., New York, N. Y.
Oakite Products, Inc., 22 Thames St., New York City
Philadelphia Quartz Co., 121-129 S. Third St., Philadelphia, Pa.
Pilley Packing & Flue Brush Co., Fort Madison, Iowa
Solvay Sales Corp., 40 Rector St., New York City
Warner Chemical Co., Chrysler Bldg., New York City

CLOCKS—Instrument:
American Recording Chart Co., 3113 E. 11th St., Los Angeles, Calif.
Engineering Laboratories, Tulsa, Okla.
Foxboro Co., Foxboro, Mass.
Marsh, Jas. P., Corp., 2073 Southport, Chicago, Ill.
Standard Electric Time Co., Springfield, Mass.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

CLOTH, Filter—See FILTERS:

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Cambridge Wire Cloth Co., Cambridge, Md.
Cyclone Fence Division of American Steel & Wire Co., Stanley Ave., North Chicago, Ill.
Jelliff, C. O., Mfg. Corp., The, Southport, Conn.
Michigan Wire Cloth Co., 2080 Howard, Detroit, Mich.
Multi-Metal Wire Cloth Co., Inc., 1350 Garrison Ave., Bronx, New York City
Newark Wire Cloth Co., Newark, N. J.
Roebling's, John A., Sons Co., Trenton, N. J.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Truscon Steel Co., Youngstown, Ohio
Tyler, W. S., Co., 3615 Superior Ave., Cleveland, Ohio
Wickwire Spencer Steel Co., 500 Fifth Ave., New York City

CLOTHING—Asbestos:
Asbestos & Engineering Products, Ltd., London, Eng.
Boyer-Campbell Co., 6540 St. Antoine St., Detroit, Mich.
Davis Emergency Equipment Co., Inc., Newark, N. J.
Ehret Magnesia Manufacturing Co., Valley Forge, Pa.
Industrial Products Co., 2828 N. Fourth St., Philadelphia, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Mattison Co., Ambler, Pa.
Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.
Pulmosan Safety Equipment Co., Brooklyn, N. Y.
Strauss Co., 925 Liberty Ave., Pittsburgh, Pa.

COAL PULVERIZERS—See PULVERIZERS, Coal:

COATINGS—High-Temperature—See INSULATION:

COATINGS—Pipe—See PROTECTIVE COATINGS, Pipe:

COATINGS—Protective, Furnace:
Acme White Lead & Color Works, 8250 St. Aubin, Detroit, Mich.
Arco Co., 7301 Bessemer Ave., Cleveland, Ohio
Dearborn Chemical Co., 310 S. Michigan, Ave., Chicago, Ill.
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Horn, A. C., Co., Houston, Tex.
Johns-Manville Corp., 22 E. 40th St., New York City
Lucas, Robert M., Co., 1955 W. 31st St., Chicago, Ill.
National Engineering Products, Inc., 4100 Georgia Ave., Washington, D. C.
Protective Coatings, Inc., 10391 Northlawn, Detroit, Mich.
Quigley Co., Inc., 56 W. 45th St., New York City
Tnemec Co., Inc., Kansas City, Mo.
U. S. Stoneware Co., The, 60 E. 42nd St., New York City

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Gato Valve Co., 1430 Oliver Bldg., Pittsburgh, Pa.
Inferno Co., Shreveport, La.
Jerguson Gage & Valve Co., Somerville, Mass.
Klingerit, Inc., 16 Hudson St., New York City
Lonergan, J. E., Corp., 211 Race St., Philadelphia, Pa.
Lunkenheimer Co., The, Cincinnati, Ohio
Marsh, Jas. P., Corp., 2073 Southport, Chicago, Ill.
Nathan Mfg. Co., 416 E. 106th St., New York City
Newman, Hender & Co., Ltd., Woodchester, Glos., England
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.
Powell, Wm., Co., The, Cincinnati, Ohio
Richard Klinger Ltd., Sidcup, Kent, Eng.
Swift Lubricator Co., Elmira, N. Y.

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COCKS—Stop, Brass:
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Detroit Brass & Malleable Works, 100 S. Campbell Ave., Detroit, Mich.
Jarecki Mfg. Co., St. Louis, Mo.
Lunkenheimer Co., The, Cincinnati, Ohio
Merco Nordstrom Valve Co., 400 Lexington Ave., Pittsburgh, Pa.
Mueller Co., Decatur, Ill.
National Airoil Burner Co., 1284 E. Sedgley Ave., Philadelphia, Pa.
Newman, Hender & Co., Ltd., Woodchester, Glos., England
Walworth Co., 60 E. 42nd St., New York City

COCKS—Stop, C. I.:
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Detroit Brass & Malleable Works, 100 S. Campbell Ave., Detroit, Mich.
Jarecki Mfg. Co., St. Louis, Mo.
Merco Nordstrom Valve Co., 400 Lexington Ave., Pittsburgh, Pa.
Mueller Co., Decatur, Ill.
National Airoil Burner Co., 1284 E. Sedgley Ave., Philadelphia, Pa.
Newman Hender & Co., Ltd., Woodchester, Glos., England
Oil Well Supply Co., Dallas, Tex.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Reading-Pratt & Cady Div. of the American Chain & Cable Co., Inc., Reading, Pa.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Walworth Co., 60 E. 42nd St., New York City

COCKS—Stop, Steel:
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Merco Nordstrom Valve Co., 400 Lexington Ave., Pittsburgh, Pa.
National Airoil Burner Co., 1284 E. Sedgley Ave., Philadelphia, Pa.
Newman, Hender & Co., Ltd., Woodchester, Glos., England
Richard Klinger Ltd., Sidcup, Kent, Eng.

COILS, Pipe—See PIPE COILS:

COKING DRUMS—See VESSELS, Pressure:

COLUMNS, Fractionating—See FRACTIONATING COLUMNS:

COLUMNS—Water, Safety-Alarm:
Coy Co., Jos. A., Inc., Tulsa, Okla.
Fischer & Porter Co., Hatboro, Pa.
Hunt Tool Co., Houston, Tex.
Inferno Co., Shreveport, La.
Kieley & Mueller, Inc., 40 W. 13th St., New York City
Lunkenheimer Co., The, Cincinnati, Ohio
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Shand & Jurs Co., Berkeley, Calif.
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

COMBUSTIBLE GAS ALARMS—See ALARMS, Combustible Gas:

COMBUSTION-CONTROL EQUIPMENT—See SPECIFIC EQUIPMENT:

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Acme White Lead & Color Works, 8250 St. Aubin, Detroit, Mich.
American-Marietta Co., 43 E. Ohio, Chicago, Ill.
American Sand-Banum Co., 9 Rockefeller Plaza, New York City
Arco Co., 7301 Bessemer Ave., Cleveland, Ohio
Cantleek Products Corp., Flushing, N. Y.
Du Pont de Nemours, E. I., & Co., Inc., Wilmington, Del.
Greene, Tweed & Co., 101 Park Ave., New York City

Horn, A. C., Co., Houston, Tex.
Jenkins Brothers, 80 White St., New York City
Kay Co., East St. Louis, Ill.
McDonald, A. Y., Mfg. Co., Dubuque, Iowa.
National Engineering Products, Inc., 4100 Georgia Ave., Washington, D. C.
Quigley Co., Inc., 56 W. 45th St., New York City
Rector Well Equip. Co., Fort Worth, Tex.
Reilly Tar & Chemical Co., Indianapolis, Ind.
Rockwood Sprinkler Co., Worcester, Mass.
Smooth-On Mfg. Co., Jersey City, N. J.
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Clark Bros. Co., Box 560, Olean, N. Y.
Cooper-Bessemer Corp., The, Mount Vernon, Ohio
Davey Compressor Co., Kent, Ohio
DeLaval Steam Turbine Co., Trenton, N. J.
Fuller Co., Catasauqua, Pa.
Gardner Denver Co., Quincy, Ill.
Harley Sales Co., Tulsa, Okla.
Ingersoll-Rand Co., 11 Broadway, New York City
LeRoi Co., Milwaukee, Wis.
Nash Engr. Co., South Norwalk, Conn.
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Spray Engineering Co., Somerville, Mass.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Sullivan Machinery Co., Michigan City, Ind.
Union Steam Pump Co., Battle Creek, Mich.
Westinghouse Air Brake Co., Wilmerding, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

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Cooper-Bessemer Corp., The, Mount Vernon, Ohio
Frick Co., Waynesboro, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City
Worthington Pump & Machinery Corp., Harrison, N. J.

COMPRESSORS—Gas, Angle-Type, Gas-Engine Driven:
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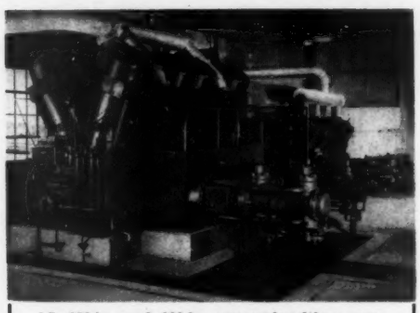
Cooper-Bessemer Corp., The, Mount Vernon, Ohio
Ingersoll-Rand Co., 11 Broadway, New York City



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Gardner Denver Co., Quincy, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Union Steam Pump Co., Battle Creek, Mich.
Worthington Pump & Machinery Corp., Harrison, N. J.

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Cooper-Bessemer Corp., The, Mount Vernon, Ohio
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National Transit Pump & Machine Co., Oil City, Pa.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Worthington Pump & Machinery Corp., Harrison, N. J.

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Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Clark Bros. Co., Box 560, Olean, N. Y.
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Harley Sales Co., Tulsa, Okla.
Ingersoll-Rand Co., 11 Broadway, New York City
LeRoi Co., Milwaukee, Wis.
Schramm, Inc., West Chester, Pa.
Sullivan Machinery Co., Michigan City, Ind.
Westinghouse Air Brake Co., Wilmerding, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

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Bury Compressor Co., Erie, Pa.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York
Clark Bros. Co., Box 560, Olean, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City
National Transit Pump & Machine Co., Oil City, Pa.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Worthington Pump & Machinery Corp., Harrison, N. J.

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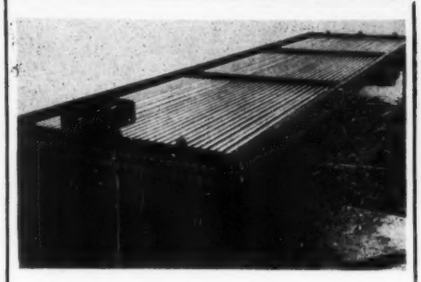
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Coy Co., Jos. A., Inc., Tulsa, Okla.
Engineers & Fabricators, Inc., Houston, Tex.



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Struthers-Wells Co., Div. of Struthers Wells-Titusville Corp., Warren, Pa.
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CONDENSER BOXES—See BOXES, Condenser:

CONDENSER TUBES—See TUBES, Condenser:

CONDENSERS—Ammonia:
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Biggs Boiler Works, The, Akron, Ohio
Blaw-Knox Co., Blawnox, Pa.
Carrier Corp., Syracuse, N. Y.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
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Engineers & Fabricators, Inc., Houston, Tex.
Frick Co., Waynesboro, Pa.
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National Radiator Corp., Johnstown, Pa.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Struthers-Wells Co., Div. of Struthers Wells-Titusville Corp., Warren, Pa.
Vogt, Henry, Machine Co., Louisville, Ky.
Worthington Pump & Machinery Corp., Harrison, N. J.

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Ampco, Engineering & Construction Co., Dallas, Tex.
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees, Eng.
Blickman, S., Inc., Weehawken, N. J.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Croll-Reynolds Engineering Co., 17 John St., New York City
Devine, J. P., Mfg. Co., Mount Vernon, Ill.
Elliott Co., Jeannette, Pa.
Goslin Birmingham Mfg. Co., Inc., 350 Madison Ave., New York City
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Worthington Pump & Machinery Corp., Harrison, N. J.

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Biggs Boiler Works, The, Akron, Ohio
Blickman, S., Inc., Weehawken, N. J.
Coy Co., Jos. A., Inc., Tulsa, Okla.
Engineers & Fabricators, Inc., Houston, Tex.
Foster Wheeler Corp., 6 Church St., New York City
Griscom-Russell Co., The, 285 Madison Ave., New York City
Hendrick Mfg. Co., Carbondale, Pa.
Hudson Engineering Co., Houston, Tex.
Kellogg Co., M. W., 225 Broadway, New York City
Leach, C. H. Co., 117 Liberty St., New York City
Lummus Co., 420 Lexington Ave., New York City
McNamar Boiler & Tank Co., Tulsa, Okla.
National Radiator Corp., Johnstown, Pa.
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CONDENSERS—Reflux:
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Coy Co., Jos. A., Inc., Tulsa, Okla.
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Foster Wheeler Corp., 165 Broadway, New York City
Kellogg Co., M. W., 225 Broadway, New York City
Leach, C. H., Co., Inc., 117 Liberty St., New York City
Lummus Co., The, 420 Lexington Ave., New York City
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Southwestern Engineering Co., Los Angeles, Calif.
Tulsa Boiler & Machinery Co., Tulsa, Okla.

CONDENSERS—Sectional:
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Ampco, Engineering & Construction Co., Dallas, Tex.
Beaird Corp., J. B., Shreveport, La.
Blickman, S., Inc., Weehawken, N. J.
Coy Co., Jos. A., Inc., Tulsa, Okla.
Griscom-Russell Co., The, 285 Madison Ave., New York City
Hudson Engineering Co., Houston, Tex.
Lummus Co., 420 Lexington Ave., New York City
National Radiator Corp., Johnstown, Pa.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.

CONDENSERS—Submerged:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Ampco, Engineering & Construction Co., Dallas, Tex.
Biggs Boiler Works, The, Akron, Ohio
Coy Co., Jos. A., Inc., Tulsa, Okla.
Engineers & Fabricators, Inc., Houston, Tex.
Griscom-Russell Co., The, 285 Madison Ave., New York City
Hudson Engineering Co., Houston, Tex.
Lummus Co., 420 Lexington Ave., New York City
National Radiator Corp., Johnstown, Pa.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vogt, Henry, Machine Co., Louisville, Ky.

CONDENSERS—Surface:
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Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
Ampco, Engineering & Construction Co., Dallas, Tex.
Biggs Boiler Works, The, Akron, Ohio
Blickman, S., Inc., Weehawken, N. J.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Croll-Reynolds Engineering Co., 17 John St., New York City
Devine, J. P., Mfg. Co., Mount Vernon, Ill.
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., 6 Church St., New York City
Goslin Birmingham Mfg. Co., Inc., 350 Madison Ave., New York City
Hendrick Mfg. Co., Carbondale, Pa.
Hudson Engineering Co., Houston, Tex.
Ingersoll-Rand Co., 11 Broadway, New York City
Kellogg Co., M. W., 225 Broadway, New York City
Lummus Co., 420 Lexington Ave., New York City
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National Radiator Corp., Johnstown, Pa.
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Worthington Pump & Machinery Corp., Harrison, N. J.
Young Radiator Co., Racine, Wis.

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Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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CONSTRUCTION — Refinery — See ENGINEERING and CONSTRUCTION, Refinery:

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Fischer & Porter Co., Hatboro, Pa.
Fisher Governor Co., Marshalltown, Iowa
Foxboro Co., Foxboro, Mass.
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Hagan Corp., 300 Ross St., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Kieley & Mueller, Inc., 40 W. 13th St., New York City
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
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Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Refinery Supply Co., Tulsa, Okla.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Taylor Instrument Companies, Rochester, N. Y.
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Westinghouse Air Brake Co., Wilmerding, Pa.

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Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cash, A. W., Co., Decatur, Ill.
Cutler-Hammer, Inc., Milwaukee, Wis.
Detroit Lubricator, 5900 Trumbull Ave., Detroit, Mich.
Fischer & Porter Co., Hatboro, Pa.
Fisher Governor Co., Marshalltown, Iowa
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Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Penn Electric Switch Co., Goshen, Ind.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Sarco Co., Inc., 475 Fifth Ave., New York City
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Webster Engineering Co., Tulsa, Okla.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

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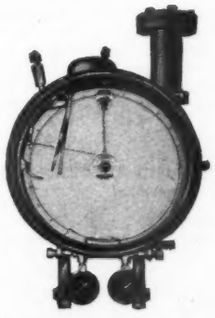

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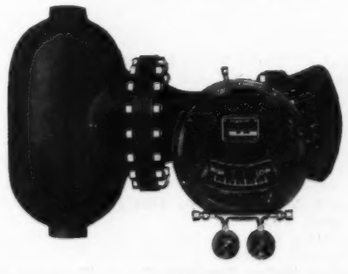

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Cutler-Hammer, Inc., Milwaukee, Wis.
Fisher Governor Co., Marshalltown, Iowa
Foster Engineering Co., Newark, N. J.
Foxboro Co., Foxboro, Mass.
General Electric Co., Schenectady, N. Y.
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Standard Conveyor Co., St. Paul, Minn.

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Wyatt Metal & Boiler Works, Houston, Tex.

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Lunkenheimer Co., The, Cincinnati, Ohio
Nathan Mfg. Co., 416 E. 106th St., New York City
Newman, Hender & Co., Ltd., Woodchester, England
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.
Powell, Wm., Co., The, Cincinnati, Ohio
Swift Lubricator Co., Elmira, N. Y.

CUTTING TORCHES — See WELDING and CUTTING EQUIPMENT

DAMPERS:
American Manganese Steel Co., 389 E. 14th St., Chicago Heights, Ill.
Green Fuel Economizer Co., Inc., Beacon, N. Y.
Inferno Co., Shreveport, La.

DEEP-WELL TURBINE PUMPS — See PUMPS, Turbine, Deep-Well:

DEAERATORS:
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Croll-Reynolds Engineering Co., 17 John St., New York City
Elliott Co., Jeannette, Pa.
Graver Tank & Mfg. Co., 4809 Todd, East Chicago, Ind.
Worthington Pump & Machinery Corp., Harrison, N. J.
Wyatt Metal & Boiler Works, Houston, Tex.

DEPHLEGMATORS—Plant:
Biggs Boiler Works, The, Akron, Ohio
Blaw-Knox Co., Blawnox, Pa.
Hendrick Mfg. Co., Carbondale, Pa.
Oxley Engineering Co., Ltd., London, Eng.
Tulsa Boiler & Machinery Co., Tulsa, Okla.

DESALTING—Crude-Oil—See PLANTS, Desalting:

DESUPERHEATERS:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., 6 Church St., New York City
Hagan Corp., 300 Ross St., Pittsburgh, Pa.
Northern Equipment Co., Erie, Pa.
Spence Engineering Co., Inc., Walden, N. Y.

DETECTORS—Hydrogen Sulfide:
Davis Emergency Equipment Co., Inc., Newark, N. J.
Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.

DEWAXING EQUIPMENT:
Biggs Boiler Works, The Akron, Ohio
Foster Wheeler Corp., 6 Church St., New York City
Hendrick Mfg. Co., Carbondale, Pa.
Sharples Corp., 23rd and Westmoreland Sts., Philadelphia, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

DEWAXING PROCESSES—See PROCESSES, Dewaxing:

DIE STOCKS:
Armstrong Bros. Tool Co., 317 N. Francisco, Chicago, Ill.
Beaver Pipe Tools, Inc., Warren, Ohio
Crown Die & Tool Co., Chicago, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jarecki Mfg. Co., Erie, Pa.
Nye Tool & Machine Works, Chicago, Ill.
Oster Mfg. Co., Cleveland, Ohio
Ridge Tool Co., Elyria, Ohio
Toledo Pipe Threading Machine Co., Toledo, Ohio

DIESEL ENGINES—See ENGINES, Diesel:

DISKS—Wire-Screen for Clay Towers, Etc.:
Michigan Wire Cloth Co., 2080 Howard St., Detroit, Mich.

DISTILLATION UNITS—See PROCESSES, Refinery:

DOCK HOSE—See HOSE:

DOORS, Fire—See FIRE DOORS:

DRAINERS—Continuous Discharge:
Fisher Governor Co., Marshalltown, Iowa
Kieley & Mueller, Inc., 40 W. 13th St., New York City
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

DRESSING—Belt:
Acheson Colloids Corp., Port Huron, Mich.
Alexander Brothers, Inc., 405 N. Third St., Philadelphia, Pa.
Browning Mfg. Co., Maysville, Ky.
Cling Surface Co., Buffalo, N. Y.
Dick, R. and J., Co., Passaic, N. J.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Graton & Knight Mfg. Co., Worcester, Mass.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Houghton, E. F., Co., Third, American and Somerset Sts., Philadelphia, Pa.
Manhattan Rubber Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Rockwood Mfg. Co., Indianapolis, Ind.
Rossendale-Ruboil Co., Newark, N. J.
Ton-Tex Corp., Grand Rapids, Mich.

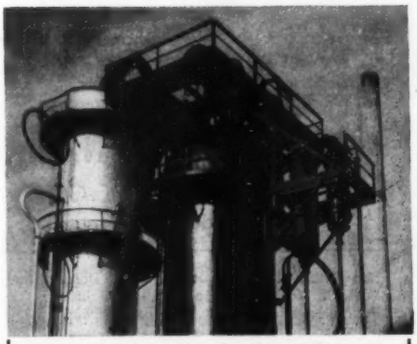
DRILLS—Pneumatic:
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Gardner Denver Co., Quincy, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City
Sullivan Machinery Co., Michigan City, Ind.
Worthington Pump & Machinery Corp., Harrison, N. J.

DRIVES—Chain—See CHAINS, Transmission:

DYES—Gasoline:
American Aniline Products, Inc., 50 Union Square East, New York City
American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York City
Patent Chemicals, Inc., Jersey City, N. J.

EJECTORS—Air:
Ampco, Engineering & Construction Co., Dallas, Tex.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Croll-Reynolds Engineering Co., 17 John St., New York City
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., 6 Church St., New York City
Ingersoll-Rand Co., 11 Broadway, New York City
Nathan Mfg. Co., 416 E. 106th St., New York City
Shand & Jurs Co., Berkeley, Calif.
Worthington Pump & Machinery Corp., Harrison, N. J.

EJECTORS—Steam Jet:
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Croll-Reynolds Engineering Co., 17 John St., New York City
Duriron Co., The, Inc., Dayton, Ohio
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., 6 Church St., New York City
Haveg Corp., Newark, Del.
Ingersoll-Rand Co., 11 Broadway, New York City



Three-stage I-R ejector with two big boosters and a booster condenser serving a large vacuum distillation unit in an oil refinery.

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The installation shown was designed to handle 10,000 pounds of steam per hour, plus 200 pounds of air per hour and 100 pounds of oil vapors per hour at 32 mm., Hg., abs. When installed in 1937, these big booster ejectors were believed to be the largest in the world in this kind of service.

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Ohio Injector Co., Wadsworth, Ohio
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Shand & Jurs Co., Berkeley, Calif.
Worthington Pump & Machinery Corp., Harrison, N. J.

ELECTRIC CABLE—See CABLE, Electric:

ELECTRIC CIRCUIT BREAKERS—See CIRCUIT BREAKERS, Electric:

ELECTRIC LANTERNS—See LANTERNS, Electric:

ELECTRIC MOTORS—See MOTORS, Electric:

ELECTRIC-MOTOR CONTROLLERS—See CONTROLLERS, Electric-Motor:

ELECTRIC-MOTOR STARTERS—See STARTERS, Electric-Motor:

ELECTRIC SWITCHES—See SWITCHES, Electric:

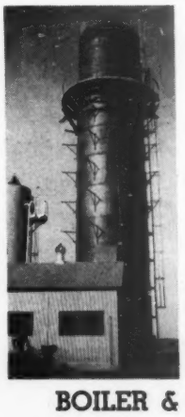
ELECTRIC WELDING MACHINES—See WELDERS, Electric Arc:

ELECTRODES — Welding — See WELDING RODS and ELECTRODES:

ELECTRODE HOLDERS — See WELDING ELECTRODE HOLDERS:

ELLS—Welding:
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Limbert, George B., Co., 570 Fulton, Chicago, Ill.
Midwest Piping & Supply Co., St. Louis, Mo.
Taylor Forge & Pipe Works, Cicero, Ill.
Walworth Co., 60 E. 42nd St., New York City
Watson-Stillman Co., Fitting Div., Roselle, N. J.

ENGINEERING and CONSTRUCTION—Natural-Gasoline Plant:
Ampco, Engineering & Construction Co., Dallas, Tex.
Braun & Co., C. F., Alhambra, Calif.
Fluor Corp., Ltd., Box 7030, Los Angeles, Calif.
Foster Wheeler Corp., 6 Church St., New York City
Frick-Reid Supply Corp., Tulsa, Okla.
Gasoline Plant Construction Co., Houston, Tex.
Hudson Engineering Co., Houston, Tex.
McNamar Boiler & Tank Co., Tulsa, Okla.



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Natural Gasoline Plant Equipment of all kinds.

Shop or field erection.

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Parkhill Wade Co., Los Angeles, Calif.
Petroleum Engineering, Inc., Tulsa, Okla.
Pritchard, J. F., Co., Kansas City, Mo.
Stearns-Roger Mfg. Co., Denver, Colo.

ENGINEERING and CONSTRUCTION—Refinery:
Alcorn Combustion Co., 15th and Race Sts., Philadelphia, Pa.
Ampco, Engineering & Construction Co., Dallas, Tex.
Badger, E. B., Sons Co., Boston, Mass.
Bechtel-McCone-Parsons Corp., 601 W. Fifth St., Los Angeles, Calif.
Blaw-Knox Co., Blawnox, Pa.
Born Engr. Co., Tulsa, Okla.
Braun & Co., C. F., Alhambra, Calif.
Donelly Process Corp., 20 N. Wacker Drive, Chicago, Ill.
Fluor Corp., Ltd., Box 7030, Los Angeles, Calif.
Foster Wheeler Corp., 6 Church St., New York City
Frick-Reid Supply Corp., Tulsa, Okla.
Gasoline Plant Construction Co., Houston, Tex.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Gray Processes Corp., 135 E. 42nd St., New York City
Hudson Engineering Co., Houston, Tex.
Kellogg, M. W., Co., 225 Broadway, New York City
Lummus Co., 1250 Graybar Bldg., New York City
Matteson-Wallack & Co., Britton, Okla.
McKee & Co., A. G., Cleveland, Ohio
Meritt-Chapman & Scott Corp., 17 Battery Place, New York City
Mid-Continent Engineering Co., Inc., Dallas, Tex.
Miller, Max B., and Co., Inc., 501 Fifth Ave., New York City
Mose-Turner Engr. Co., Tulsa, Okla.
Parkhill Wade Co., Los Angeles, Calif.
Petroleum Conversion Corp., Elizabeth, N. J.
Petroleum Engineering, Inc., Tulsa, Okla.
Pritchard, J. F., Co., Kansas City, Mo.
Smith Engineering Co., Kansas City, Mo.
Stearns-Roger Mfg. Co., 1720 California St., Denver, Colo.
Stone & Webster Engr. Corp., 49 Federal St., Boston, Mass.
Stratford Engineering Corp., Kansas City, Mo.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Universal Oil Products Co., 310 S. Michigan Ave., Chicago, Ill.
Vapor Recovery Systems Co., Compton, Calif.
Winkler-Koch Engineering Co., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.

ENGINEERING—Process—See ENGINEERING and CONSTRUCTION, Refinery, also PROCESSES, Refinery:

ENGINEERS, Designing — See ENGINEERING and CONSTRUCTION, Refinery:

ENGINEERS—Erecting—See ENGINEERING and CONSTRUCTION, Refinery:

ENGINES—Air-Cooled:
Continental Motors Corp., Muskegon, Mich.
LeRoi Co., Milwaukee, Wis.
Novo Engine Co., Lansing, Mich.
Waukesha Motor Co., Waukesha, Wis.
Wisconsin Motor Corp., Milwaukee, Wis.

ENGINES—Convertible, Gas or Oil:
Buda Co., Harvey, Ill.
Clark Bros. Co., Box 560, Olean, N. Y.
Continental Motors Corp., Muskegon, Mich.
Cooper-Bessemer Corp., The, Mount Vernon, Ohio
Ingersoll-Rand Co., 11 Broadway, New York City
Minneapolis-Moline Power Implement Co., Minneapolis, Minn.
National Supply Co., Toledo, Ohio
Waukesha Motor Co., Waukesha, Wis.
Weber Engine Works, Kansas City, Mo.
Worthington Pump & Machinery Corp., Harrison, N. J.

ENGINES—Diesel:
Allen Sons & Co., Ltd., W. H., Bedford, England
American Locomotive Co., 30 Church St., New York City
Baldwin De La Vergne Sales Corp., Paschall P. O., Philadelphia, Pa.
Buda Co., Harvey, Ill.
Buffalo Gasolene Motor Co., Buffalo, N. Y.
Busch Sulzer Bros., Diesel Engine, St. Louis, Mo.
Caterpillar Tractor Co., Peoria, Ill.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Clark Bros. Co., Box 560, Olean, N. Y.
Cooper-Bessemer Corp., The, Mount Vernon, Ohio
Cummins Engine Co., Columbus, Ind.
Fairbanks, Morse Co., 600 S. Michigan Ave., Chicago, Ill.
General Motors Corp. of the Diesel Engine Division, Detroit, Mich.
General Motors Corp., Lagrange, Ill.
Hercules Motors Corp., Canton, Ohio
Ingersoll-Rand Co., 11 Broadway, New York City
International Harvester Co., 180 N. Michigan Ave., Chicago, Ill.
Murphy Diesel Co., Milwaukee, Wis.
National Supply Co., Toledo, Ohio
Sun Shipbuilding & Drydock Co., Chester, Pa.
Weber Engine Works, Kansas City, Mo.
Witte Engine Works, Kansas City, Mo.
Worthington Pump & Machinery Corp., Harrison, N. J.

ENGINES—Gas:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bruce-Macbeth Engine Co., 2111 Center St., Cleveland, Ohio
Buda Co., Harvey, Ill.
Buffalo Gasolene Motor Co., Buffalo, N. Y.
Caterpillar Tractor Co., Peoria, Ill.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Clark Bros. Co., Box 560, Olean, N. Y.
Climax Engineering Co., Dallas, Tex.
Continental Motors Corp., Muskegon, Mich.
Cooper-Bessemer Corp., The, Mount Vernon, Ohio
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Hercules Motors Corp., Canton, Ohio
Ingersoll-Rand Co., 11 Broadway, New York City
International Harvester Co., 180 N. Michigan Ave., Chicago, Ill.
LeRoi Co., Milwaukee, Wis.
Marion Machine Foundry & Supply Co., Marion, Ind.
Minneapolis-Moline Power Implement Co., Minneapolis, Minn.
National Supply Co., Toledo, Ohio
National Transit Pump & Machine Co., Oil City, Pa.
Novo Engine Co., Lansing, Mich.
Waukesha Motor Co., Waukesha, Wis.
Weber Engine Works, Kansas City, Mo.
Wisconsin Motor Corp., Milwaukee, Wis.
Worthington Pump & Machinery Corp., Harrison, N. J.

ENGINES—Gasoline:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Car & Foundry Co., 30 Church St., New York City
Buda Co., Harvey, Ill.
Buffalo Gasolene Motor Co., Buffalo, N. Y.
Climax Engineering Co., Dallas, Tex.
Continental Motors Corp., Muskegon, Mich.
Domestic Engine & Pump Co., Shippensburg, Pa.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Hercules Motors Corp., Canton, Ohio
International Harvester Co., 180 N. Michigan Ave., Chicago, Ill.
LeRoi Co., Milwaukee, Wis.
Minneapolis-Moline Power Implement Co., Minneapolis, Minn.
Novo Engine Co., Lansing, Mich.
Waukesha Motor Co., Waukesha, Wis.
Wisconsin Motor Corp., Milwaukee, Wis.
Witte Engine Works, Kansas City, Mo.

ENGINES—Steam:
Allen & Sons, Ltd., W. H., Bedford, England
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Elliott Co., Jeannette, Pa.
Oil Well Supply Co., Dallas, Tex.
Wheland Co., Chattanooga, Tenn.
Wilson-Snyder Mfg. Div. of Oil Well Supply Co., Braddock, Pa.

EQUIPMENT—Chemical-Control—See CHEMICAL CONTROL EQUIPMENT:

EQUIPMENT — Dewaxing — See DEWAXING EQUIPMENT:

EQUIPMENT—Laboratory — See LABORATORY EQUIPMENT and SUPPLIES:

EVAPORATORS:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Biggs Boiler Works, The, Akron, Ohio
Blaw-Knox Co., Blawnox, Pa.
Blickman, S., Inc., Weehawken, N. J.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.

Four 275-hp V-type gas engines driving Class RT centrifugal pipe-line pumps which handle crude from the Ventura field. Intermediate station has two 485-hp engines of same type driving larger pumps of the same class.

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The Type PVG gas engine built for full-load operation at the moderate speed of 400 rpm. It is of 4-cycle, V-type, multi-cylinder construction and is available with 4, 6 and 8 cylinders in 185, 275 and 370 hp. sizes.

Larger gas engines are available in two sizes, a 6-cylinder unit of 600 hp and an 8-cylinder unit of 800 hp.

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POWER AND PUMPING EQUIPMENT FOR FIELD OR REFINERY

● The Fairbanks-Morse line of power and pumping equipment is one of the most complete in the United States. Included are Diesels, pumps, electric motors, and gas engines—all manufactured by a company whose experience and understanding of the problems of the oil industry enables them to build products that assure dependable, economical service under the most severe operating conditions. Write for complete information or bulletins.

A ten hp. Fairbanks-Morse "ZC" engine operating on 1700 ft. well with ¾ inch rods and 2 inch pump. Seventeen 34-inch strokes per minute are made.

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Gasoline Plant Construction Co., Houston, Tex.
Goslin Birmingham Mfg. Co., Inc., 350 Madison Ave. New York City
Griscom-Russell Co., The, 285 Madison Ave., New York City
Haveg Corp., Newark, Del.
Hendrick Mfg. Co., Carbondale, Pa.
Henzzey Co., Watertown, Wis.
Kellogg Co., M. W., 225 Broadway, New York City
Lancaster Iron Works, Lancaster, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.
Manistee Iron Works, Manistee, Mich.
Muskegon Boiler Works, Muskegon, Mich.
Oxley Engineering Co., Ltd., London, Eng.
Struthers-Wells Co., Div. of Struthers Wells-Titusville Corp., Warren, Pa.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vulcan Steel Tank Corp., Tulsa, Okla.
Wyatt Metal & Boiler Works, Houston, Tex.
Young Radiator Co., Racine, Wis.

EXCHANGERS—Heat—See HEAT EXCHANGERS:

EXHAUSTERS and BLOWERS — Manhole — See BLOWERS and EXHAUSTERS, Manhole:

EXHAUST FANS—See FANS, Exhaust:

EXHAUSTERS—Steam Jet:
Champion Blower & Forge Co., Lancaster, Pa.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Continental-Diamond Fibre Co., Bridgeport, Conn.
Croll-Reynolds Engineering Co., 17 John St., New York City
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., 6 Church St., New York City
Haveg Corp., Newark, Del
McNamar Boiler & Tank Co., Tulsa, Okla.
Schutte & Koerting Co., 1116 Thompson St., Philadelphia, Pa.
Shand & Jurs Co., Berkeley, Calif.

EXPANDERS—Tube:
Airetool Mfg. Co., The, Springfield, Ohio
Henderer's, A. L., Sons, East Wilmington, Del.
Key Co., East St. Louis, Ill.
Leach, C. H., Co., Inc., 117 Liberty St., New York City
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.

EXPANSION JOINTS—See JOINTS, Expansion:

EXTINGUISHERS—Fire—See FIRE EXTINGUISHERS:

EXTRACTORS—Mist:
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Blaw-Knox Co., Blawnox, Pa.
Knight, Maurice A., Akron, Ohio
McNamar Boiler & Tank Co., Tulsa, Okla.
Stearns-Roger Mfg. Co., Denver, Colo.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vulcan Steel Tank Corp., Tulsa, Okla.
Wyatt Metal & Boiler Works, Houston, Tex.

FABRICATED METAL INSULATION—See INSULATION, Fabricated Metal:

FABRICATED PIPING—See PREFABRICATED PIPING:

FABRICATED STEEL:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Allied Steel Products Corp., Tulsa, Okla.
American Bridge Co., Frick Bldg., Pittsburgh, Pa.
American Car & Foundry Co., 30 Church St., New York City
American Steel Works, Kansas City, Mo.
Beaird Corp., J. B., Shreveport, La.
Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Blaw-Knox Co., Blawnox, Pa.
Butler Mfg. Co., Kansas City, Mo.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Graver Tank & Mfg. Co., 4809 Todd, East Chicago, Ind.
Hendrick Mfg. Co., Carbondale, Pa.
Kellogg Co., M. W., 225 Broadway, New York City
Lancaster Iron Works, Lancaster, Pa.
Lorenson Matthews Mfg. Co., Dickson City, Pa.
Lucey Boiler & Mfg. Co., Chattanooga, Tenn.
McNamar Boiler & Tank Co., Tulsa, Okla.
Mosher Steel Co., Houston, Tex.
Muskegon Boiler Works, Muskegon, Mich.
National Radiator Corp., Johnstown, Pa.
Oxley Engineering Co., Ltd., London, England
Patterson Steel Co., Tulsa, Okla.
Pfaudler Co., The, Rochester, N. Y.
Pittsburgh-Des Moines Steel Co., Newille Island P.O., Pittsburgh, Pa.
Sun Shipbuilding & Dry Dock Co., Chester, Pa.
Truscon Steel Co., Youngstown, Ohio
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vulcan Steel Tank Corp., Tulsa, Okla.
Watkins, Inc., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.
Youngstown Metal Products Co., Youngstown, Ohio

FANS—Cooling:
Aerovent Fan Co., Piqua, Ohio
Allen Corp., 9751 Erwin Ave., Detroit, Mich.
American Blower Corp., 6000 Russell Ave., Detroit, Mich.
American Machine & Metals, Inc., of the Debothezat Ventilating Equipment Division, East Moline, Ill.
Butane Equipment Co., Dallas, Tex.
Carrier Corp., Syracuse, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.
Coppus Engineering Co., 344 Park Ave., New York City
Good-All Electric Mfg. Co., Ogallala, Neb.
Green Fuel Economizer Co., Inc., Beacon, N. Y.
Happy Co., The, Tulsa, Okla.
Robbins & Myers, Inc., Springfield, Ohio
Schubert-Christy Corp., St. Louis, Mo.
South Bend Air Products, Inc., South Bend, Ind.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Wagner Electric Corp., St. Louis, Mo.

FANS—Exhaust:
Aerovent Fan Co., Piqua, Ohio
Allen Corp., 9751 Erwin Ave., Detroit, Mich.
American Blower Corp., 6000 Russell Ave., Detroit, Mich.
American Machine & Metals, Inc., of the Debothezat Ventilating Division, East Moline, Ill.
Binks Mfg. Co., 3124 Carroll Ave., Chicago, Ill.
Butane Equipment Co., Dallas, Tex.
Champion Blower & Forge Co., Lancaster, Pa.
Coppus Engineering Co., 344 Park Ave., New York City
Dual Air Fan Co., 711 W. Lake St., Chicago, Ill.
Green Fuel Economizer Co., Inc., Beacon, N. Y.
Pangborn Corp., Hagerstown, Md.
Robbins & Myers, Inc., Springfield, Ohio
South Bend Air Products, Inc., South Bend, Ind.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Wagner Electric Corp., St. Louis, Mo.

FANS—Recirculating:
Aerovent Fan Co., Piqua, Ohio
Allen Corp., 9751 Erwin Ave., Detroit, Mich.
American Blower Corp., 6000 Russell Ave., Detroit, Mich.
American Machine & Metals, Inc., of the Debothezat Ventilating Equipment Division, East Moline, Ill.
Champion Blower & Forge Co., Lancaster, Pa.
Dual Air Fan Co., 711 W. Lake St., Chicago, Ill.
Green Fuel Economizer Co., Inc., Beacon, N. Y.
South Bend Air Products, Inc., South Bend, Ind.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Wagner Electric Corp., St. Louis, Mo.

FANS—Ventilating:
Aerovent Fan Co., Piqua, Ohio
Allen Corp., 9751 Erwin Ave., Detroit, Mich.
American Blower Corp., 6000 Russell Ave., Detroit, Mich.
American Machine & Metals, Inc., of the Debothezat Ventilating Equipment Division, East Moline, Ill.
Butane Equipment Co., Dallas, Tex.
Carrier Corp., Syracuse, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.
Coppus Engineering Co., 344 Park Ave., New York City
Dual Air Fan Co., 711 W. Lake St., Chicago, Ill.
Green Fuel Economizer Co., Inc., Beacon, N. Y.
Haveg Corp., 919 N. Michigan, Chicago, Ill.
Jeffrey Mfg. Co., The, Columbus, Ohio
Robbins & Myers, Inc., Springfield, Ohio
South Bend Air Products, Inc., South Bend, Ind.
Stearns-Roger Mfg. Co., Denver, Colo.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Wagner Electric Corp., St. Louis, Mo.

FEEDERS—Boiler Compound:
Bird Archer Co., 2030 N. Natchez Ave., Chicago, Ill.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, Ill.
Elgin Softener Corp., Elgin, Ill.
Fischer & Porter Co., Hatboro, Pa.
Haering, D. W., & Co., 205 West Wacker Drive, Chicago, Ill.
Horn, A. C., Co., Houston, Tex.
%Proportioneers, Inc.%, Providence, R. I.
Roy, Milton, Pumps, 1300 E. Mermaid Ave, Philadelphia, Pa.
Sims Co., The, Erie, Pa.

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Designed according to most advanced aerodynamic principles. Powerful air blast is effective up to distance of 125 feet. Built for easy portability and to withstand severest service. Conforms to all state Safety Regulations.

Guard faces 2" square mesh, rim ½" mesh expanded metal.
Unbreakable aluminum alloy non-sparking blades. 24 to 36 inch diameter.
FAN-COOLED, EXPLOSION-PROOF UNIT.
Explosion-proof metal conduit and switch.
Adjustable motor support for changing direction of blast.
Frame of rugged welded metal tubing and rolled steel.
Tripod base with two wide-rim wheels for quick and easy moving over rough surfaces.

DYNAFLOW

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Fram Corp., Pawtucket Ave., East Providence, R. I.
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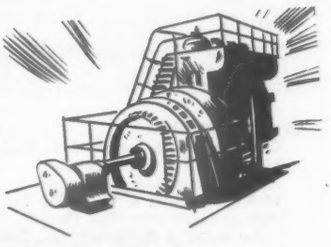

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Kropp Forge Co., 5301 W. Roosevelt Rd., Chicago, Ill.
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Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa.
Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
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FLEXIBLE TUBING—See TUBING, Flexible, Metal:

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Oliver Iron & Steel Corp., 1001 Muriel St., Pittsburgh, Pa.
Philadelphia Steel & Iron Co., Conshohocken, Pa.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Sheffield Steel Corp., Kansas City, Mo.
Steel Improvement & Forge Co., The, 960 Addison Rd., Cleveland, Ohio
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American Locomotive Co., Alco Products Div., 30 Church St., New York City
Badger, E. B., & Sons Co., Boston, Mass.
Beaird Corp., J. B., Shreveport, La.
Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Blaw-Knox Co., Blawnox, Pa.
Braun, C. F., & Co., Inc., Alhambra, Calif.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
Devine, J. P., Mfg. Co., Mount Vernon, Ill.
Fansteel Metallurgical Corp., North Chicago, Ill.
Foster Wheeler Corp., 6 Church St., New York City
Gasoline Plant Construction Co., Houston, Tex.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Hudson Engineering Co., Houston, Tex.
Kellogg Co., M. W., 225 Broadway, New York City
Lancaster Iron Works, Lancaster, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.
National Tank Co., Tulsa, Okla.
Podbielniak Centrifugal Super-Contactor Co., 8312 S. Chicago, Chicago, Ill.
Stearns-Roger Mfg. Co., Denver, Colo.
Sun Shipbuilding & Drydock Co., Chester, Pa.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vogt, Henry, Machine Co., Louisville, Ky.
Vulcan Steel Tank Corp., Tulsa, Okla.
Watkins, Inc., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.

FRACTIONATING TOWERS—See TOWERS, Fractionating:

FULLERS EARTH:
Attapulgus Clay Co., 260 S. Broad St., Philadelphia, Pa.
Earthen Products, Inc., Houston, Tex.
Floridin Co., Warren, Pa.
Illinois Minerals Co., Cairo, Ill.
Opper, F. H., Inc., Savannah, Ga.

FURFURAL:
Quaker Oats Co., 141 W. Jackson Blvd., Chicago, Ill.

FURNACES—Boiler:

Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bigelow-Liptak Corp., 2842 W. Grand Blvd., Detroit, Mich.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Detrick, M. H., Co., 140 S. Dearborn, Chicago, Ill.
Foster Wheeler Corp., 6 Church St., New York City
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.

FURNACES—Oil:

Aeroil Burner Co., Inc., 561 Park Ave., West New York, N. J.
Alcorn Combustion Co., 15th and Race Sts., Philadelphia, Pa.
Bigelow-Liptak Corp., 2842 W. Grand Blvd., Detroit, Mich.
Detrick, M. H., Co., 140 S. Dearborn, Chicago, Ill.
Foster Wheeler Corp., 6 Church St., New York City
Kellogg Co., M. W., 225 Broadway, New York City
Petro-Chem Development Co., Inc., 120 E. 41st St., New York City
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Stratford Engineering Corp., Kansas City, Mo.

FURNACES—Still:

Alcorn Combustion Co., 15th and Race Sts., Philadelphia, Pa.
Bigelow-Liptak Corp., 2842 W. Grand Blvd., Detroit, Mich.
Braun, C. F., & Co., Inc., Alhambra, Calif.
Detrick, M. H., Co., 140 S. Dearborn, Chicago, Ill.
Foster Wheeler Corp., 6 Church St., New York City
Kellogg Co., M. W., 225 Broadway, New York City
Petro-Chem Development Co., Inc., 120 E. 41st St., New York City
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.

FUSIBLE PLUGS—See PLUGS, Fusible:

GAUGE GLASSES:

Burt Tank, Separator & Oil Treating Corp., Wichita Falls, Tex.
Corning Glass Works, Corning, N. Y.
Inferno Co., Shreveport, La.
Jerguson Gage & Valve Co., Somerville, Mass.

Lunkenheimer Co., The, Cincinnati, Ohio
Nathan Mfg. Co., 416 E. 106th St., New York City
National Lead Co., 111 Broadway, New York City
Powell, Wm., Co., The, Cincinnati, Ohio
Swift Lubricator Co., Elmira, N. Y.
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

GALVANOMETERS:

Cambridge Instrument Co., Inc., 3732 Grand Central Terminal, New York City
Engineering Laboratories, Tulsa, Okla.
Foxboro Co., Foxboro, Mass.
General Electric Co., Schenectady, N. Y.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Weston Electrical Instrument Corp., Newark, N. J.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

GAS COOLERS—See COOLERS, Gas:

GAS BURNERS—See BURNERS, Gas:

GAS COMPRESSORS—See COMPRESSORS:

GAS ENGINES—See ENGINES, Gas:

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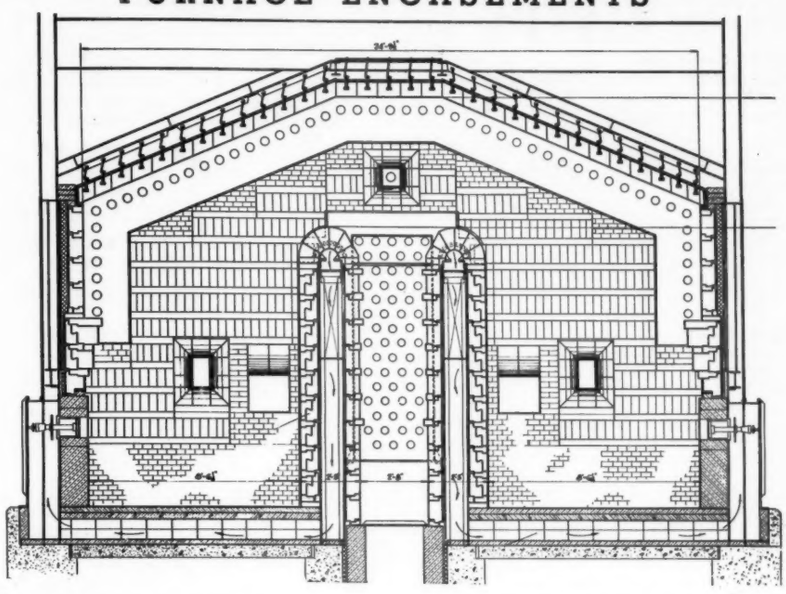

Typical of the many complete furnace encasements of Bigelow-Liptak Unit—Suspended Arch and Wall Construction, is this double-end fired reforming furnace installed in large Mid-Continent Refinery.

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BIGELOW - LIPTAK CORPORATION
2842 W. Grand Blvd. Detroit, Mich.

GAS HOLDERS:

Bethlehem Steel Co., Bethlehem, Pa.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Graver Tank & Mfg. Co., Inc., East Chicago, Ind.
Koppers Co., Koppers Bldg., Pittsburgh, Pa.
Lancaster Iron Works, Lancaster, Pa.
Oxley Engineering Co., Ltd., London, England
Pittsburgh-Des Moines Steel Co., Neville Island P.O., Pittsburgh, Pa.
Stacey Bros. Gas Construction Co., Cincinnati, Ohio
Stearns-Roger Mfg. Co., Denver, Colo.

GAS METERS—See METERS, Gas:

GAS and OIL BURNERS—See BURNERS:

GAS DEHYDRATION PROCESSES — See PROCESSES, Gas Dehydration:

GAS POLYMERIZATION—See PROCESSES, Refinery:

GAS-PURIFICATION PROCESSES — See PROCESSES, Gas:

GAS REVERSION—See PROCESSES, Refinery:

GAS SCRUBBERS—See SCRUBBERS, Gas:

GASKETS—Aluminum:

Akron Metallic Gasket Co., Akron, Ohio
Azor Corp., Federal Trust Bldg., Newark, N. J.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Goetze Gasket & Packing Co., New Brunswick, N. J.
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Asbestos:

Akron Metallic Gasket Co., Akron, Ohio
Asbestos & Engineering Products, Ltd., London, England
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Durabla Mfg. Co., 114 Liberty St., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Hewitt Rubber Corp., Buffalo, N. Y.
Jenkins Brothers, 80 White St., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Klingerit, Inc., 16 Hudson St., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
Quaker Rubber Corp., Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Russell Mfg. Co., Middletown, Conn.
U. S. Rubber Co., 1230 Sixth Ave., New York City
Vellumoid Co., Worcester, Mass.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Copper:

Akron Metallic Gasket Co., Akron, Ohio
Azor Corp., Federal Trust Bldg., Newark, N. J.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Goetze Gasket & Packing Co., New Brunswick, N. J.
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Cork:

Akron Metallic Gasket Co., Akron, Ohio
Armstrong Cork Products Co., Lancaster, Pa.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.

Johns-Manville Corp., 22 E. 40th St., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Vellumoid Co., Worcester, Mass.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Corrugated:
Akron Metallic Gasket Co., Akron, Ohio
Azor Corp., Federal Trust Bldg., Newark, N. J.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Johns-Manville Corp., 22 E. 40th St., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Fiber:
Akron Metallic Gasket Co., Akron, Ohio
Armstrong Cork Products Co., Lancaster, Pa.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Darcold Co., Inc., 149 Sixth Ave., New York City
Frick Co., Waynesboro, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Haveg Corp., Newark, Del.
Johns-Manville Corp., 22 E. 40th St., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Maloney, F. H., Co., Houston, Tex.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
Quaker Rubber Corp., Philadelphia, Pa.
Russell Mfg. Co., Middletown, Conn.
U. S. Rubber Co., 1230 Sixth Ave., New York City
Vellumoid Co., Worcester, Mass.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Lead:
Akron Metallic Gasket Co., Akron, Ohio
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Darcold Co., Inc., 149 Sixth Ave., New York City
Frick Co., Waynesboro, Pa.
Goetze Gasket & Packing Co., New Brunswick, N. J.
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Metallo Gasket Co., New Brunswick, N. J.
National Lead Co., 111 Broadway, New York City
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Leather:
Alexander Brothers, Inc., 405 N. Third St., Philadelphia, Pa.
Auer, C. L. and W. W., Corry, Pa.
Chicago Belting Co., 125 N. Green, Chicago, Ill.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Excelsior Leather Washer Co., Rockford, Ill.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Graton & Knight Mfg. Co., Worcester, Mass.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Houghton, E. F., Co., Third, American and Somerset Sts., Philadelphia, Pa.
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Preston, Horace G., Co., 2581 Beecher St., Detroit, Mich.
Rhoads, J. E., & Sons, 35 N. Sixth St., Philadelphia, Pa.
Schieren, Charles A., Co., 30 Ferry St., New York City
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Metallic:
Akron Metallic Gasket Co., Akron, Ohio
Azor Corp., Federal Trust Bldg., Newark, N. J.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcold Co., Inc., 149 Sixth Ave., New York City
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Johns-Manville Corp., 22 E. 40th St., New York City
Kellogg Co., M. W., 225 Broadway, New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Maloney, F. H., Co., Houston, Tex.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
National Engineering Products, Inc., 4100 Georgia Ave., Washington, D. C.
Quaker Rubber Corp., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City, N. J.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Plastic:
Cantleek Products Corp., Flushing, N. Y.
Chicago Belting Co., 125 N. Green, Chicago, Ill.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcold Co., Inc., 149 Sixth Ave., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Haveg Corp., Newark, Del.
Johns-Manville Corp., 22 E. 40th St., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
National Engineering Products, Inc., 4100 Georgia Ave., Washington, D. C.
Nelson Electric Mfg. Co., Tulsa, Okla.
Quaker Rubber Corp., Philadelphia, Pa.
Resistoflex Corp., Belleville, N. J.
U. S. Stoneware Co., The, 60 E. 42nd St., New York City
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Ring:
Akron Metallic Gasket Co., Akron, Ohio
Azor Corp., Federal Trust Bldg., Newark, N. J.
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Darcold Co., Inc., 149 Sixth Ave., New York City
Durabla Mfg. Co., 114 Liberty St., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Jenkins Brothers, 80 White St., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
Quaker Rubber Corp., Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Steel Improvement & Forge Co., The, 960 Addison Rd., Cleveland, Ohio
Vellumoid Co., Worcester, Mass.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Rubber:
Akron Metallic Gasket Co., Akron, Ohio
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Belting Co., 125 N. Green, Chicago, Ill.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Dresser Mfg. Co., Bradford, Pa.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Frick Co., Waynesboro, Pa.
Garlock Packing Co., Palmyra, N. Y.
General Tire & Rubber Co., Akron, Ohio
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Hewitt Rubber Corp., Buffalo, N. Y.
Jenkins Brothers, 80 White St., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Lima Cord Sole & Heel Co., Lima, Ohio
Lithox Corp., The, Wapakoneta, Ohio
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Quaker Rubber Corp., Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Republic Rubber Co., The, Youngstown, Ohio
U. S. Rubber Co., 1230 Sixth Ave., New York City
U. S. Stoneware Co., The, 60 E. 42nd St., New York City
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.
Westinghouse Air Brake Co., Wilmerding, Pa.

GASKETS—Semimetallic:
Akron Metallic Gasket Co., Akron, Ohio
Azor Corp., Federal Trust Bldg., Newark, N. J.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
National Engineering Products, Inc., 4100 Georgia Ave., Washington, D. C.
Quaker Rubber Corp., Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Sheet:
Akron Metallic Gasket Co., Akron, Ohio
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcold Co., Inc., 149 Sixth Ave., New York City
Durabla Mfg. Co., 114 Liberty St., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Johns-Manville Corp., 22 E. 40th St., New York City
Klingerit, Inc., 16 Hudson St., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
Quaker Rubber Corp., Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Resistoflex Corp., Belleville, N. J.
U. S. Rubber Co., 1230 Sixth Ave., New York City
U. S. Stoneware Co., The, 60 E. 42nd St., New York City
Vellumoid Co., Worcester, Mass.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Steel:
Akron Metallic Gasket Co., Akron, Ohio
Azor Corp., Federal Trust Bldg., Newark, N. J.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Johns-Manville Corp., 22 E. 40th St., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
Steel Improvement & Forge Co., The, 960 Addison Rd., Cleveland, Ohio
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASOLINE DYES—See DYES, Gasoline:

GAUGE COCKS—See COCKS, Gauge:

GAUGE HATCHES—See TANK GAUGE and THIEF HATCHES:

GAUGE-REPAIR SERVICE—See INSTRUMENT-REPAIR SERVICE:

GAUGE-TESTING EQUIPMENT:
Ashton Valve Co., Cambridge, Mass.
Blackhawk Mfg. Co., Milwaukee, Wis.
Crosby Steam Gage & Valve Co., 30 Church St., New York City
Engineering Laboratories, Tulsa, Okla.
Grove Regulator Co., Oakland, Calif.
Lonergan, J. E., Corp., 211 Race St., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2073 Southport, Chicago, Ill.
Marshalltown Mfg. Co., 549 W. Randolph, Chicago, Ill.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.

GAUGES—Absolute Pressure:
Bristol Co., The, Waterbury, Conn.
Engineering Laboratories, Tulsa, Okla.
Foxboro Co., Foxboro, Mass.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2073 Southport, Chicago, Ill.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
United States Gauge Co., 44 Beaver St., New York City

GAUGES—Automatic, Tank:

Guardian Electric Co., 1623 W. Walnut St., Chicago, Ill.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Nathan Mfg. Co., 416 E. 106th St., New York City
Pneumercator Co., 305 E. 46th St., New York City
Shand & Jurs Co., Berkeley, Calif.
Swift Lubricator Co., Elmira, N. Y.
Tokheim Co., Cedar Rapids, Iowa
Vapor Recovery Systems Co., Compton, Calif.
Viking Pump Co., Cedar Falls, Iowa

GAUGES—Compound Pressure and Vacuum, Indicating:

Ashton Valve Co., Cambridge, Mass.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Crosby Steam Gage & Valve Co., 30 Church St., New York City
Engineering Laboratories, Tulsa, Okla.
Foxboro Co., Foxboro, Mass.
Lonergan, J. E., Corp., 211 Race St., Philadelphia, Pa.
Kent, Geo., Ltd., Luton, England
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2073 Southport, Chicago, Ill.
Marshalltown Mfg. Co., 549 W. Randolph, Chicago, Pa.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Newman, Hender & Co., Ltd., Woodchester, England
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
United States Gauge Co., 44 Beaver St., New York City

GAUGES—Draft:

Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Foxboro Co., Foxboro, Mass.
Hays, A. M., Corp., Michigan City, Ind.
Kent, Geo., Ltd., Luton, England
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.

GAUGES—Hydraulic:

Ashton Valve Co., Cambridge, Mass.
Blackhawk Mfg. Co., Milwaukee, Wis.
Bristol Co., The, Waterbury, Conn.
Crosby Steam Gage & Valve Co., 30 Church St., New York City
Foxboro Co., Foxboro, Mass.
Kent, Geo., Ltd., Luton, England
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2073 Southport, Chicago, Ill.
Marshalltown Mfg. Co., 549 W. Randolph, Chicago, Ill.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Newman, Hender & Co., Ltd., Woodchester, England
United States Gauge Co., 44 Beaver St., New York City

GAUGES—Liquid Level, Indicating:

Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.
Bowser, S. F., & Co., Fort Wayne, Ind.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Crosby Steam Gage & Valve Co., 30 Church St., New York City
Foxboro Co., Foxboro, Mass.
Frick Co., Waynesboro, Pa.
General Electric Co., Schenectady, N. Y.
Guardian Electric Co., 1623 W. Walnut St., Chicago, Ill.
Inferno Co., Shreveport, La.
Jerguson Gage & Valve Co., Somerville, Mass.
Johnston & Jennings, 877 Addison Rd., Cleveland, Ohio
Kent, Geo., Ltd., Luton, England
King Engineering Corp., Ann Arbor, Mich.
King-Seeley Corp., Ann Arbor, Mich.
Klingerit, Inc., 16 Hudson St., New York City
Liquidometer Corp., The, Long Island City, N. Y.
Lunkenheimer Co., The, Cincinnati, Ohio
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marshalltown Mfg. Co., 549 W. Randolph, Chicago, Ill.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Nathan Mfg. Co., 416 E. 106th St., New York City
Newman, Hender & Co., Ltd., Woodchester, England
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.
Powell, Wm., Co., The, Cincinnati, Ohio
Rochester Mfg. Co., Inc., Rochester, N. Y.
Shand & Jurs Co., Berkeley, Calif.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Swift Lubricator Co., Elmira, N. Y.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
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Vapor Recovery Systems Co., Compton, Calif.
Viking Pump Co., Cedar Falls, Iowa
Vogt, Henry, Machine Co., Louisville, Ky.
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Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

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Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Crosby Steam Gage & Valve Co., 30 Church St., New York City
Foxboro Co., Foxboro, Mass.
Kent, Geo., Ltd., Luton, England
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Liquidometer Corp., The, Long Island City, N. Y.
McAlear Mfg. Co., 1901 S. Western, Chicago, Ill.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

GAUGES—Pressure, Indicating:

Ashton Valve Co., Cambridge, Mass.
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Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Connelly Iron Sponge & Governor Co., 3154 S. California, Chicago, Ill.
Crosby Steam Gage & Valve Co., 30 Church St., New York City
Engineering Laboratories, Tulsa, Okla.
Foxboro Co., Foxboro, Mass.
General Electric Co., Schenectady, N. Y.
Hays, A. M., Corp., Michigan City, Ind.
Kent, Geo., Ltd., Luton, England
King-Seeley Corp., Ann Arbor, Mich.
Lonergan, J. E., Corp., 211 Race St., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2073 Southport, Chicago, Ill.
Marshalltown Mfg. Co., 549 W. Randolph, Chicago, Ill.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa.
Rochester Mfg. Co., Rochester, N. Y.
Star Brass Mfg. Co., Boston, Mass.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
United States Gauge Co., 44 Beaver St., New York City
Westinghouse Air Brake Co., Wilmerding, Pa.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

GAUGES—Pressure, Recording:

Ashton Valve Co., Cambridge, Mass.
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
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Detroit Lubricator, 5900 Trumbull Ave., Detroit, Mich.
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Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Nathan Mfg. Co., 416 E. 106th St., New York City
National Airoil Burner Co., 1284 E. Sedgley Ave., Philadelphia, Pa.
Newman, Hender & Co., Ltd., Woodchester, England
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.

Precision Scientific Co., 1750 N. Springfield Ave., Chicago, Ill.
Rochester Mfg. Co., Inc., Rochester, N. Y.
Shand & Jurs Co., Berkeley, Calif.
Swift Lubricator Co., Elmira, N. Y.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Tokheim Co., Cedar Rapids, Iowa
Vapor Recovery Systems Co., Compton, Calif.
Viking Pump Co., Cedar Falls, Iowa

GAUGES—Reflex:
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Klingerit, Inc., 16 Hudson St., New York City
Nathan Mfg. Co., 416 E. 106th St., New York City
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.
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Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
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Precision Scientific Co., 1750 N. Springfield Ave., Chicago, Ill.
Rochester Mfg. Co., Inc., Rochester, N. Y.
Sarco Co., Inc., 475 Fifth Ave., New York City
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United States Gauge Co., 44 Beaver St., New York City
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Engineering Laboratories, Tulsa, Okla.
Foxboro Co., Foxboro, Mass.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
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Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
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Taylor Instrument Companies, Rochester, N. Y.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

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Johnston & Jennings, Oceco Div., 877 Addison Rd., Cleveland, Ohio
Klingerit, Inc., 16 Hudson St., New York City
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Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.
Resistoflex Corp., Belleville, N. J.

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GAUGES—Vacuum, Indicating:
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Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
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Hays, A. M., Corp., Michigan City, Ind.
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Lonergan, J. E., Corp., 211 Race St., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
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Marshalltown Mfg. Co., 549 W. Randolph, Chicago, Ill.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
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Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa.
Rochester Mfg. Co., Rochester, N. Y.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
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Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Crosby Steam Gage & Valve Co., 30 Church St., New York City
Esterline Angus Co., Indianapolis, Ind.
Foxboro Co., Foxboro, Mass.
Hays, A. M., Corp., Michigan City, Ind.
Kent, Geo., Ltd., Luton, England
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2073 Southport, Chicago, Ill.
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Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa.
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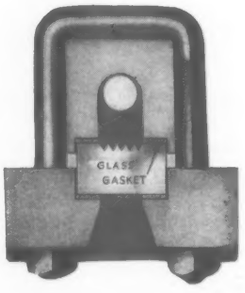

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General Electric Co., Schenectady, N. Y.
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Falk Corp., Milwaukee, Wis.
Farrel-Birmingham Co., Inc., Buffalo, N. Y.
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James, D. O., Mfg. Co., 114 Monroe St., Chicago, Ill.
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Medart Co., St. Louis, Mo.
National Supply Co., Toledo, Ohio
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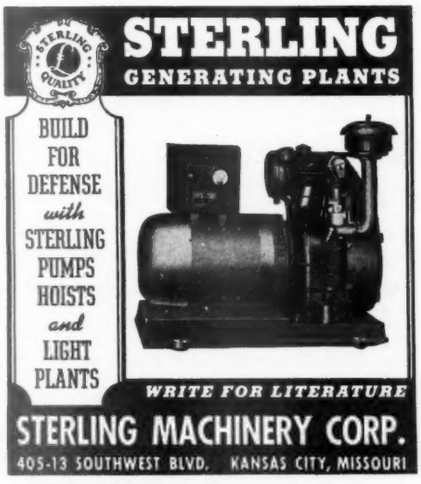
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

GENERATING PLANTS—Gasoline-Driven:

Sterling Machinery Corp., Kansas City, Mo.



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Allis-Chalmers Mfg. Co., Milwaukee, Wis.
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Buffalo Gasolene Motor Co., Buffalo, N. Y.
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Weber Engine Works, Kansas City, Mo.
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Electric Machinery Mfg. Co., Minneapolis, Minn.
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Nelson Electric Mfg. Co., Tulsa, Okla.
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Moon Mfg. Co., 122 N. Jefferson, Chicago, Ill.
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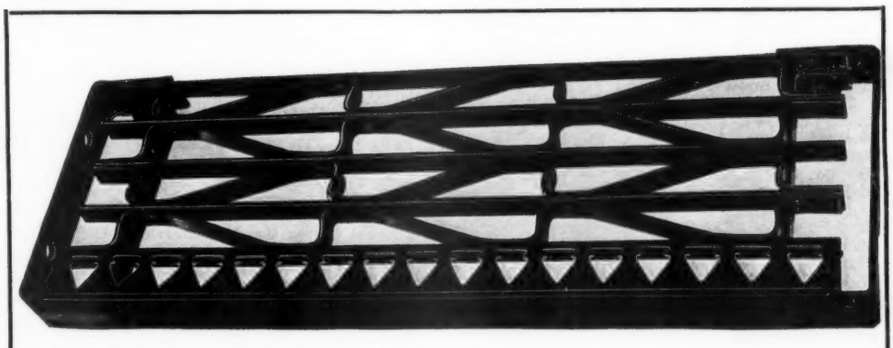
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Tulsa Boiler & Machinery Co., Tulsa, Okla.
Watkins, Inc., Wichita, Kans.

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GREASE CUPS—See CUPS, Grease:

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Hendrick Mfg. Co., Carbondale, Pa.
Sowers Mfg. Co., Buffalo, N. Y.
Stratford Engineering Corp., Kansas City, Mo.

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HANGERS—Tube—See SUPPORTS, Tube:

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Shand & Jurs Co., Berkeley, Calif.
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Kellogg Co., M. W., 225 Broadway, New York City
Key Co., East St. Louis, Ill.
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Ohio Steel Foundry Co., The, Springfield, Ohio
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Ampco Engineering & Construction Co., Dallas, Tex.
Babcock & Wilcox Co., The, 85 Liberty St., New York City
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Braun, C. F., & Co., Inc., Alhambra, Calif.
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Coy, Jos. A., Co., Inc., Tulsa, Okla.
Croll-Reynolds Engineering Co., 17 John St., New York City
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Henzzey Co., Watertown, Wis.
Hudson Engineering Co., Houston, Tex.
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Marley Co., The, Kansas City, Kans.
National Carbon Co., Inc., Cleveland, Ohio
National Radiator Corp., Johnstown, Pa.
Oxley Engineering Co., Ltd., London, England
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Whiting Corp., Harvey, Ill.
Whitlock Mfg. Co., Hartford, Conn.
Wyatt Metal & Boiler Works, Houston, Tex.
Young Radiator Co., Racine, Wis.

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American Locomotive Co., Alco Products Div., 30 Church St., New York City
American Blower Corp., 6000 Russell Ave., Detroit, Mich.
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Foster Wheeler Corp., 6 Church St., New York City
General Electric Co., Schenectady, New York City
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Griscom-Russell Co., The, 285 Madison Ave., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
McNamar Boiler & Tank Co., Tulsa, Okla.
National Radiator Corp., Johnstown, Pa.
Oxley Engineering Co., Ltd., London, England
Struthers-Wells Co., Div. of Struthers Wells-Titusville Corp., Warren, Pa.
Sturtevant, B. F., C., Hyde Park, Boston, Mass.

HEATERS—Feed Water:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Beaird Corp., J. B., Shreveport, La.
Biggs Boiler Works, The, Akron, Ohio
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Coy Co., Jos. A., Inc., Tulsa, Okla.
Croll-Reynolds Engineering Co., 17 John St., New York City
Elliott Co., Jeannette, Pa.
Engineers & Fabricators, Inc., Houston, Tex.
Foster Wheeler Corp., 6 Church St., New York City
Griscom-Russell Co., The, 285 Madison Ave., New York City
McNamar Boiler & Tank Co., Tulsa, Okla.
Oil Well Supply Co., Dallas, Tex.
Petro-Chem Development Co., Inc., 120 E. 41st. St., New York City
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Sims Co., The, Erie, Pa.
Struthers-Wells Co., Div. of Struthers Wells-Titusville Corp., Warren, Pa.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Weir, Ltd., G. & J., Glasgow, Scotland
Wilson-Snyder Mfg. Div. of Oil Well Supply Co.., Braddock, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

HEATERS—Oil:
Aeroil Burner Co., Inc., 561 Park Ave., West New York, N. J.
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Alcorn Combustion Co., 15th and Race Sts., Philadelphia, Pa.
American District Steam Co., North Tonawanda, N. Y.
Ampco Engineering & Construction Co., Dallas, Tex.
Babcock & Wilcox Co., The, 85 Liberty St., New York City
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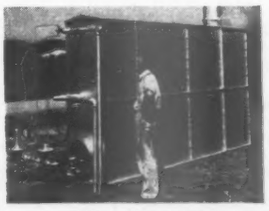
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Lummus Co., 420 Lexington Ave., New York City
McNamar Boiler & Tank Co., Tulsa, Okla.
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Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vogt, Henry, Machine Co., Louisville, Ky.
Winkler-Koch Engineering Co., Wichita, Kans.

HEATERS—Steam Jet:
Duriron Co., The, Inc., Dayton, Ohio
Elliott Co., Jeannette, Pa.
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.

HEATERS—Storage Tank:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
American District Steam Co., North Tonawanda, N. Y.
Beaird Corp., J. B., Shreveport, La.
Biggs Boiler Works, The, Akron, Ohio
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Devine, J. P., Manufacturing Co., Mount Vernon, Ill.
Griscom-Russell Co., The, 285 Madison Ave., New York City
Kewanee Boiler Corp., Kewanee, Ill.
National Airoil Burner Co., 1284 E. Sedgley Ave., Philadelphia, Pa.
National Radiator Corp., Johnstown, Pa.
Oxley Engineering Co., Ltd., London, England
Sims Co., The, Erie, Pa.
Struthers-Wells Co., Div. of Struthers Wells-Titusville Corp., Warren, Pa.
Tulsa Boiler & Machinery Co., Tulsa, Okla.

HOISTING BLOCKS—See BLOCKS, Hoisting:

HELMETS—Welding—See SHIELDS, Welding:

HOISTS—Air Motor:
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Ingersoll-Rand Co., 11 Broadway, New York City
Joyce-Cridland Co., The, Dayton, Ohio
Sterling Machinery Corp., Kansas City, Mo.
Sullivan Machinery Co., Michigan City, Ind.

HOISTS—Chain:
Aeroil Burner Co., Inc., 561 Park Ave., West New York, N. J.
Chance, A. B., Co., The, Centralia, Mo.
Chisholm-Moore Hoist Corp., Tonawanda, N. Y.
Coffing Hoist Co., Danville, Ill.
Ford Chain Block Division of the American Chain & Cable Co., Inc., 2nd and Diamond Sts., Philadelphia, Pa.
Harnischfeger Corp., 4400 W. National Ave., Milwaukee, Wis.
Nixdorff Krein Mfg. Co., St. Louis, Mo.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Sterling Machinery Corp., Kansas City, Mo.
Union Manufacturing Co., New Britain, Conn.
Wright Manufacturing Div. of the American Chain & Cable Co., Inc., York, Pa.
Yale & Towne Mfg. Co., Frankfort, Philadelphia, Pa.

HOISTS—Electric:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Brady Conveyors Corp., 20 W. Jackson Blvd., Chicago, Ill.
Brill Equipment Corp., 185 Varick St., New York City
Economy Engineering Co., 2675 W. Van Buren St., Chicago, Ill.
Elmco Corp., Salt Lake City, Utah
Electro Lift, Inc., 40 Church St., New York City
Harnischfeger Corp., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City
Philadelphia Gear Works, "G" St. and Erie Ave., Philadelphia, Pa.
Stephens-Adamson Mfg. Co., 63 Ridgeway Ave., Aurora, Ill.
Yale & Towne Mfg. Co., Philadelphia, Pa.

HOISTS—Portable:
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Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Coffing Hoist Co., Danville, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City
Novo Engine Co., Lansing, Mich.
Simmons Manufacturing Co., Ashland, Ohio
Sullivan Machinery Co., Michigan City, Ind.
Yale & Towne Mfg. Co., Frankfort, Philadelphia, Pa.

HOLDERS—Gas—See GAS HOLDERS:

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American Chain Div. of the American Chain & Cable Co., Inc., York, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Laughlin, Thomas, Co., Portland, Me.
Oil Well Supply Co., Dallas, Tex.
Williams, J. H., & Co., Buffalo, N. Y.

HOSE—Air:
American Brass Co., 25 Broadway, New York City
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Metal Hose Corp., Maywood, Ill.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Chiksan Tool Co., Brea, Calif.
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Elliott Co., Jeannette, Pa.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Hewitt Rubber Corp., Buffalo, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
National Airoil Burner Co., 1284 E. Sedgley Ave., Philadelphia, Pa.
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Republic Rubber Co., The, Youngstown, Ohio
Resistoflex Corp., Belleville, N. J.
Schramm, Inc., West Chester, Pa.
Sterling Packing & Gasket Co., Houston, Tex.
Sullivan Machinery Co., Michigan City, Ind.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 6th Ave., New York City
Westinghouse Air Brake Co., Wilmerding, Pa.

HOSE—Chemical:
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Metal Hose Corp., Maywood, Ill.
Chiksan Tool Co., Brea, Calif.
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Hewitt Rubber Corp., Buffalo, N. Y.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Quaker Rubber Corp., Philadelphia, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Resistoflex Corp., Belleville, N. J.
Sterling Packing & Gasket Co., Houston, Tex.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 6th Ave., New York City
Walker, W. L., Co., Tulsa, Okla.
Wallace & Tiernan Co., Belleville, N. J.

HOSE COUPLINGS:
American Brass Co., 25 Broadway, New York City
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Metal Hose Corp., Maywood, Ill.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Newman, Hender & Co., Ltd., Woodchester, England
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Republic Rubber Co., The, Youngstown, Ohio
Resistoflex Corp., Belleville, N. J.
Scovill Mfg. Co., Waterbury, Conn.
Sterling Packing & Gasket Co., Houston, Tex.
Sullivan Machinery Co., Michigan City, Ind.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 6th Ave., New York City

HOSE—Exhaust, Flexible Metal:
American Brass Co., 25 Broadway, New York City
Atlantic Metal Hose Co., 123 W. 64th St., New York City
Chicago Metal Hose Corp., Maywood, Ill.
Chiksan Tool Co., Brea, Calif.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Seamlex Co., Inc., 5-19 48th Ave., Long Island City, N. Y.

HOSE—Flexible Metal:
American Brass Co., 25 Broadway, New York City
Atlantic Metal Hose Co., 123 W. 64th St., New York City
Chicago Metal Hose Corp., Maywood, Ill.
Chiksan Tool Co., Brea, Calif.
Darling Valve & Mfg. Co., Williamsport, Pa.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
National Airoil Burner Co., 1284 E. Sedgley Ave., Philadelphia, Pa.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Seamlex Co., Inc., 5-19 48th Ave., Long Island City, N. Y.

HOSE—Gasoline:
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Metal Hose Corp., Maywood, Ill.
Chiksan Tool Co., Brea, Calif.
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Hewitt Rubber Corp., Buffalo, N. Y.
McDonald, A. Y., Mfg. Co., Dubuque, Iowa
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Quaker Rubber Corp., Philadelphia, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Resistoflex Corp., Belleville, N. J.
Sterling Packing & Gasket Co., Houston, Tex.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 6th Ave., New York City

HOSE—Oil:
American Brass Co., 25 Broadway, New York City
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Metal Hose Corp., Maywood, Ill.
Chiksan Tool Co., Brea, Calif.
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Hewitt Rubber Corp., Buffalo, N. Y.
McDonald, A. Y., Mfg. Co., Dubuque, Iowa.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
National Airoil Burner Co., 1284 E. Sedgley Ave., Philadelphia, Pa.
N. Y. Rubber Corp., 9 Rockefeller Plaza, New York City
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Quaker Rubber Corp., Philadelphia, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Resistoflex Corp., Belleville, N. J.
Sterling Packing & Gasket Co., Houston, Tex.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 6th Ave., New York City

HOSE—Steam, Rubber:
Carlyle Rubber Co., 64 Park Place, New York City
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Hewitt Rubber Corp., Buffalo, N. Y.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
N. Y. Rubber Corp., 9 Rockefeller Plaza, New York
Quaker Rubber Corp., Philadelphia, Pa.
Republic Rubber Co., The, Youngstown Ohio
Sterling Packing & Gasket Co., Houston, Tex.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 6th Ave., New York City

HOSE—Steam, Metal:
American Brass Co., 25 Broadway, New York City
Atlantic Metal Hose Co., 123 W. 64th St., New York City
Chicago Metal Hose Corp., Maywood, Ill.
Chiksan Tool Co., Brea, Calif.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Quaker Rubber Corp., Philadelphia, Pa.
Seamlex Co., Inc., 5-19 48th Ave., Long Island City, N. Y.

HOSE—Suction and Discharge:
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Metal Hose Corp., Maywood, Ill.

Chiksan Tool Co., Brea, Calif.
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Hewitt Rubber Corp., Buffalo, N. Y.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
National Airoil Burner Co., 1284 E. Sedgley Ave., Philadelphia, Pa.
N. Y. Rubber Corp., 9 Rockefeller Plaza, New York City
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Quaker Rubber Corp., Philadelphia, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Seamlex Co., Inc., 5-19 48th Ave., Long Island City, N. Y.
Sterling Packing & Gasket Co., Houston, Tex.
Sullivan Machinery Co., Michigan City, Ind.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 6th Ave., New York City
Walker, W. L., Co., Tulsa, Okla.

HOSE—Tar and Asphalt:
American Brass Co., 25 Broadway, N. York City
Chicago Metal Hose Corp., Maywood, Ill.
Chiksan Tool Co., Brea, Calif.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Resistoflex Corp., Belleville, N. J.

HOSE—Water:
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Metal Hose Corp., Maywood, Ill.
Chiksan Tool Co., Brea, Calif.
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Hewitt Rubber Corp., Buffalo, N. Y.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
N. Y. Rubber Corp., 9 Rockefeller Plaza, New York City
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Quaker Rubber Corp., Philadelphia, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Sterling Packing & Gasket Co., Houston, Tex.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 6th Ave., New York City
Walker, W. L., Co., Tulsa, Okla.

HOUSES—Sectional, Wood—See BUILDINGS, Sectional, Wood:

HOUSES—Tool, Steel:
Allied Steel Products Corp., Tulsa, Okla.
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Blaw-Knox Co., Blawnox, Pa.
Braden Steel Corp., Tulsa, Okla.
Burt Tank, Separator & Treating Corp., Wichita Falls, Tex.
Butler Mfg. Co., Kansas City, Mo.
Dry Zero Corp., Marchandise Mart, Chicago, Ill.
M & V Tank Co., Wichita Falls, Tex.
Mosher Steel Co., Houston, Tex.
Truscon Steel Co., Youngstown, Ohio
Watkins, Inc., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.

HOUSES—Meter:
Allied Steel Products Corp., Tulsa, Okla.
Butler Mfg. Co., Kansas City, Mo.
Daniel Orifice Fitting Co., Los Angeles, Calif.
Dry Zero Corp., Merchandise Mart, Chicago, Ill.
Watkins, Inc., Wichita, Kans.

HYDRANTS—Fire:
Darling Valve & Mfg. Co., Williamsport, Pa.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Ludlow Valve Mfg. Co., Troy, N. Y.
M & H Valve & Fittings Co., Anniston, Ala.
Manistee Iron Works, Manistee, Mich.
Mueller Co., Decatur, Ill.

HYDROGEN SULFIDE DETECTORS—See DETECTORS, Hydrogen Sulfide:

HYDROGEN SULFIDE REMOVAL—See PROCESSES, Gas Purification:

HYDROMETERS:
Greiner, Emil, Co., 55 Van Dam St., New York City
H-B. Instrument Co., Inc., N. Broad St., Philadelphia, Pa.
Kimble Glass Co., Vineland, N. J.
Nurnberg Thermometer Co., 397 Bridge St., Brooklyn, N. Y.
Refinery Supply Co., Tulsa, Okla.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Willard Storage Battery Co., E. 131st St. and St. Clair Ave., Cleveland, Ohio

HYGROMETERS:
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Cambridge Instrument Co., Inc., 3732 Grand Central Terminal, New York City
Foxboro Co., Foxboro, Mass.
Greiner, Emil, Co., 55 Van Dam St., New York City
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Nurnberg Thermometer Co., 397 Bridge St., Brooklyn, N. Y.
Palmer Co., The, Cincinnati, Ohio
Refinery Supply Co., Tulsa, Okla.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Willard Storage Battery Co., E. 131st St. and St. Clair Ave., Cleveland, Ohio

IDLERS—Belt:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Dodge Mfg. Co., Mishawaka, Ind.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Jeffery Mfg. Co., The, Columbus, Ohio
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.
Marion Machine Foundry & Supply Co., Marion, Ind.
Medart Co., 3535 De Kalb St., St. Louis, Mo.
National Supply Co., Toledo, Ohio
Oil Well Supply Co., Dallas, Tex.

ILLUMINATORS—For Water Gauges:
Inferno Co., Shreveport, La.
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

INDICATORS—Combustible Gas—See ALARMS, Combustible Gas:

INDICATORS—Draft—See GAUGES, Draft:

INDICATORS, Liquid-Level—See GAUGES, Liquid-Level:

INDICATORS—Temperature—See GAUGES:

INHIBITORS:
American Chemical Paint Co., Ambler, Pa.
American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York City
American Lecithin Co., Inc., Elmhurst, Long Island, N. Y.
Du Pont de Nemours, E. I., & Co., Wilmington, Del.
Elgin Softener Corp., Elgin, Ill.
Horn, A. C., Co., Houston, Tex.
Nurnberg Thermometer Co., 397 Bridge St., Brooklyn, N. Y.
Reilly Tar & Chemical Co., Indianapolis, Ind.
Universal Oil Products Co., 316 S. Michigan Ave., Chicago, Ill.

INJECTORS:
American Bosch Corp., Springfield, Mass.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Nathan Mfg. Co., 416 E. 106th St., New York City
Newman, Hender & Co., Ltd., Woodchester, England
Ohio Injector Co., Wadsworth, Ohio
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.

INSPECTORS—Petroleum:
Saybolt, E. W., & Co., Houston, Tex.

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SOUTH AMERICA
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PUERTO LA CRUZ, VEN.
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GUIRIA, VEN.

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HOUSTON, TEXAS

INSTRUMENTS—Oil-Testing—See OIL-TESTING INSTRUMENTS:

INSTRUMENTS—See Specific Types:

INSTRUMENT-REPAIR SERVICE:
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Foxboro Co., Foxboro, Mass.
Instruments, Inc., Dallas, Tex.

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Minneapolis-Honewell Regulator Co., Minneapolis, Minn.
Refinery Supply Co., Tulsa, Okla.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Weston Electrical Instrument Corp., Newark, N. J.

INSULATING CEMENT—See CEMENT, Insulating:

INSULATING MATERIALS—See Specific Headings:

INSULATION—Asbestos:
Asbestos & Engineering Products, Ltd., London, England
Baldwin-Hill Co., Trenton, N. J.
Bird Archer Co., 2030 N. Natchez Ave., Chicago, Ill.
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
British Belting & Asbestos, Ltd., Yorkshire, England
Carey, Philip, Co., The, Cincinnati, Ohio
Ehret Magnesia Manufacturing Co., Valley Forge, Pa.
Forty Eight Insulations, Inc., North Aurora, Ill.
Gatke Corp., 228 N. La Salle St., Chicago, Ill.
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Mattison Co., Ambler, Pa.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Ruberoid Co., 500 5th Ave., New York City
Schundler, F. E., Co., Joliet, Ill.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Sullivan Co., The, Memphis, Tenn.
Union Asbestos & Rubber Co., Cicero, Ill.
Vermiculite Products Co., Houston, Tex.

INSULATION—Boiler:
Asbestos & Engineering Products, Ltd., London, England
Baldwin-Hill Co., Trenton, N. J.
Bird Archer Co., 2030 N. Natchez Ave., Chicago, Ill.
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
Carey, Philip, Co., The, Cincinnati, Ohio
Consolidated Expanded Metal Co., Wheeling, W. Va.
Dicalite Co., The, 120 Wall St., New York City
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Ehret Magnesia Manufacturing Co., Valley Forge, Pa.
Forty Eight Insulations, Inc., North Aurora, Ill.
Johns-Manville Corp., 22 E. 40th St., New York City
Lucey Boiler & Mfg. Co., Chattanooga, Tenn.
Mexico Refractories Co., Mexico, Mo.
Owens Corning Fiberglas Corp., Toledo, Ohio
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Quigley Co., Inc., 56 W. 45th St., New York City
Ruberoid Co., 500 5th Ave., New York City
Schundler, F. E., Co., Joliet, Ill.
Sullivan Co., The, Memphis, Tenn.
Tnemec Co., Inc., Kansas City, Mo.
Universal Zonolite Insulation Co., 135 La Salle, Chicago, Ill.
Vermiculite Products Co., Houston, Tex.
Wyodak Chemical Co., 4600 E. 71st St., Cleveland, Ohio

INSULATION—Cork:
Armstrong Cork Products Co., Lancaster, Pa.
Cork Insulation Co., Inc., 155 E. 44th St., New York City
Ehret Magnesia Manufacturing Co., Valley Forge, Pa.
Mundet Cork Co., Brooklyn, N. Y.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Vermiculite Products Co., Houston, Tex.

INSULATION—Fabricated Metal:
Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Schundler, F. E., Co., Joliet, Ill.
Truscon Steel Co., Youngstown, Ohio
Vermiculite Products Co., Houston, Tex.

INSULATION—Low-Temperature:
Armstrong Cork Products Co., Lancaster, Pa.
Baldwin-Hill Co., Trenton, N. J.
Carey, Philip, Co., The, Cincinnati, Ohio
Dry Zero Corp., Merchandise Mart, Chicago, Ill.
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Ehret Magnesia Manufacturing Co., Valley Forge, Pa.
Forty Eight Insulations, Inc., North Aurora, Ill.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Johns-Manville Corp., 22 E. 40th St., New York City
LaClede Christy Clay Products Co., St. Louis, Mo.
National Engineering Products, Inc., 4100 Georgia Ave., Washington, D. C.
Owens Corning Fiberglas Corp., Toledo, Ohio
Ruberoid Co., 500 5th Ave., New York City
Schundler, F. E., Co., Joliet, Ill.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Sullivan Co., The, Memphis, Tenn.
Universal Zonolite Insulation Co., 135 S. La Salle, Chicago, Ill.
Vermiculite Products Co., Houston, Tex.
Wyodak Chemical Co., 4600 E. 71st St., Cleveland, Ohio

INSULATION—Rock Wool:
Baldwin-Hill Co., Trenton, N. J.
Bird Archer Co., 2030 N. Natchez Ave., Chicago, Ill.
Carey, Philip, Co., The, Cincinnati, Ohio
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Ehret Magnesia Manufacturing Co., Valley Forge, Pa.
Forty Eight Insulations, Inc., North Aurora, Ill.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Mattison Co., Ambler, Pa.
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Refractory & Insulation Corp., 381 4th Ave., New York City
Ruberoid Co., 500 5th Ave., New York City
Schundler, F. E., Co., Joliet, Ill.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Vermiculite Products Co., Houston, Tex.

INSULATION—Tank:
Asbestos & Engineering Products, Ltd., London, England
Armstrong Cork Products Co., Lancaster, Pa.
Baldwin-Hill Co., Trenton, N. J.
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Ehret Magnesia Manufacturing Co., Valley Forge, Pa.
Forty Eight Insulations, Inc., North Aurora, Ill.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Johns-Manville Corp., 22 E. 40th St., New York City
Lucas, Robert M., Co., 1955 W. 31st. St., Chicago, Ill.
Owens Corning Fiberglas Corp., Toledo, Ohio
Schundler, F. E., Co., Joliet, Ill.
Self-Vulcanizing Co., 605 W. Washington, Chicago, Ill.
Sullivan Co., The, Memphis, Tenn.
Tank Seal Products Co., Tulsa, Okla.
Universal Zonolite Insulation Co., 135 S. La Salle, Chicago, Ill.
Vermiculite Products Co., Houston, Tex.
Wyodak Chemical Co., 4600 E. 71st St., Cleveland, Ohio

INTERCHANGERS—Heat—See HEAT EXCHANGERS:

ISOMERIZATION, Catalytic—See PROCESSES, Refining:

JACKS—Hydraulic-Type:
Blackhawk Mfg. Co., Milwaukee, Wis.
Buda Co., Harvey, Ill.
Duff-Norton Mfg. Co., 2709 Preble Ave., Pittsburgh, Pa.
Joyce-Cridland Co., The, Dayton, Ohio
Simmons Manufacturing Co., Ashland, Ohio
Templeton, Kenly & Co., 1020 S. Central Ave., Chicago, Ill.
Watson-Stillman Co., Fitting Div., Roselle, N. J.

JACKS—Ratchet-Type:
Buda Co., Harvey, Ill.
Coffing Hoist Co., Danville, Ill.
Duff-Norton Mfg. Co., 2709 Preble Ave., Pittsburgh, Pa.
Joyce-Cridland Co., The, Dayton, Ohio
Templeton, Kenly & Co., 1020 S. Central Ave., Chicago, Ill.

JACKS—Screw-Type:
Buda Co., Harvey, Ill.
Duff-Norton Mfg. Co., 2709 Preble Ave., Pittsburgh, Pa.
Joyce-Cridland Co., The, Dayton, Ohio
Templeton, Kenly & Co., 1020 S. Central Ave., Chicago, Ill.

JETS—Ejector-Type:
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Croll-Reynolds Engineering Co., 17 John St., New York City
Nathan Mfg. Co., 416 E. 106th St., New York City

JETS—Steam:
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Croll-Reynolds Engineering Co., 17 John St., Chicago, Ill.
Duriron Co., The, Inc., Dayton, Ohio
Foster Wheeler Corp., 6 Church St., New York City
Haveg Corp., Newark, Del.
Jarecki Mfg. Co., St. Louis, Mo.
Nathan Mfg. Co., 416 E. 106th St., New York City
National Supply Co., Toledo, Ohio
Oil Well Supply Co., Dallas, Tex.
Schutte & Koerting Co., 1116 Thompson St., Philadelphia, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

JOINTS—Expansion:
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American District Steam Co., North Tonawanda, N. Y.
Badger, E. B., & Sons Co., 75 Pitts St., Boston, Mass., Expansion Joint Div.
Walworth Co., 60 E. 42nd St., New York City
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

JOINTS—Flexible Ball:
Cast Iron Pipe Research Ass'n., 122 S. Michigan, Chicago, Ill.
Clow, James B., & Sons, 201 N. Talman, Chicago, Ill.
Morrison Brothers, Dubuque, Iowa
Oil Equipment Mfg. Co., Louisville, Ky.
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Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Croll-Reynolds Engineering Co., 17 John St., New York City
Dresser Mfg. Co., Bradford, Pa.
Goodrich, B. F., Co., Akron, Ohio
Graver Tank & Mfg. Co., 4809 Todd, East Chicago Ind.
Griscom-Russell Co., The, 285 Madison Ave, New York City
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Jarecki Mfg. Co., St. Louis, Mo.
National Valve & Mfg. Co., 3101 Liberty Ave. Pittsburgh, Pa.
Newman, Hender & Co., Ltd., Woodchester, England
Owens Corning Fiberglas Corp., Toledo, Ohio
Stearns-Roger Manufacturing Co., Denver, Colo.
Victaulic Co. of America, 30 Rockefeller Plaza, New York City
Lunkenheimer Co., The, Cincinnati, Ohio
McDonald, A. Y., Mfg. Co., Dubuque, Iowa
Morrison Brothers, Dubuque, Iowa
Mueller Co., Decatur, Ill.
Oil Equipment Mfg. Co., Louisville, Ky.
Shand & Jurs Co., Berkeley, Calif.
Staytite Co., The, Houston, Tex.
Vapor Recovery Systems Co., Compton, Calif.
Walworth Co., 60 E. 42nd St., New York City
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Wyatt Metal & Boiler Works, Houston, Tex.

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McDonald, A. Y., Mfg. Co., Dubuque, Iowa

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Biggs Boiler Works, The, Akron, Ohio
Blickman, S., Inc., Weehawken, N. J.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Hendrick Mfg. Co., Carbondale, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.
Struthers-Wells Co. Div. of Struthers Wells-Titusville Corp., Warren, Pa.

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Bethlehem Foundry & Machine Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio
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Sowers Manufacturing Co., Buffalo, N. Y.
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Biggs Boiler Works, The, Akron, Ohio
Blickman, S., Inc., Weehawken, N. J.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Graver Tank & Mfg. Co., 4809 Todd, East Chicago, Ind.
Hendrick Mfg. Co., Carbondale, Pa.
Lancaster Iron Works, Lancaster, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.
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Corning Glass Works, Corning, N. Y.
Greiner, Emil, Co., 55 Van Dam St., New York City
Kimble Glass Co., Vineland, N. J.
Podbielniak Centrifugal Super-Contractor Co., 8312 S. Chicago, Chicago, Ill.
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LINE BLINDS—See BLINDS, Line:

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Goodrich, B. F., Co., Akron, Ohio
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Haveg Corp., 919 N. Michigan, Chicago, Ill.
Haveg Corp., Newark, Del.
Knight, Maurice A., Akron, Ohio
Manhattan Rubber Mfg. Div. of Raybestos-Manhattan, Inc., Passaic, N. J.
Mexico Refractories Co., Mexico, Mo.
U. S. Stoneware Co., The, 60 E. 42nd St., New York City

LIGHTNING ARRESTORS—See ARRESTORS, Lightning:

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Blickman, S., Inc., Weehawken, N. J.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodyear Tire & Rubber Co., Akron, Ohio
Haveg Corp., 919 N. Michigan, Chicago, Ill.
Haveg Corp., Newark, Del.
Klemp, Wm. F., Co., 6624 S. Melvina, Chicago, Ill.
Knight, Maurice A., Akron, Ohio
LaClede Christy Clay Products Co., St. Louis, Mo.
National Carbon Co., Inc., Cleveland, Ohio
National Lead Co., 111 Broadway, New York City
Oxley Engineering Co., Ltd., London, England
Pfaudler Co., The, Rochester, N. Y.
Saginaw Bearing Co., Saginaw, Mich.
Self-Vulcanizing Rubber Co., 605 W. Washington, Chicago, Ill.
Shenango-Penn Mold Co., Dover, Ohio
Steel Protection & Chemical Co., Inc., Mooresville, Ind.
Sullivan Co., The, Memphis, Tenn.
Swan Laboratory, Elmira, N. Y.
U. S. Stoneware Co., The, 60 E. 42nd St., New York City
Watkins, Inc., Wichita, Kans.

LININGS—Furnace:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bird Archer Co., 2030 N. Natchez Ave., Chicago, Ill.
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Kellogg Co., M. W., 225 Broadway, New York City
LaClede Christy Clay Products Co., St. Louis, Mo.
Mexico Refractories Co., Mexico, Mo.
Norton Co., Worcester, Mass.
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Refractory & Insulation Corp., 381 4th Ave. New York City
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U. S. Stoneware Co., The, 60 E. 42nd St., New York City

LININGS—Refractory:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bird Archer Co., 2030 N. Natchez Ave., Chicago, Ill.
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
Carborundum Co., Niagara Falls, N. Y.
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Kellogg Co., M. W., 225 Broadway, New York City
Klemp, Wm. F., Co., 6624 S. Melvina, Chicago, Ill.
LaClede Christy Clay Products Co., St. Louis, Mo.
Mexico Refractories Co., Mexico, Mo.
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Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Refractory & Insulation Corp., 381 4th Ave. New York City
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., The, 60 E. 42nd St., New York City

LIQUID LEVEL GAUGES—See GAUGES, Liquid Level:

LITHARGE:
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National Lead Co., 111 Broadway, New York City

LOCK NUTS—See NUTS, Lock:

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General Electric Co., Schenectady, N. Y.
Jeffrey Mfg. Co., The, Columbus, Ohio
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Whitcomb Locomotive Co., The, subsidiary of Baldwin Locomotive Co., Rochelle, Ill.

LOOK BOXES—See BOXES, Look:

LOW-TEMPERATURE INSULATION—See INSULATION, Low-Temperature:

LUBRICATING DEVICES—See Specific Items:

LUBRICATORS—Force-Feed:
Bowser, S. F., & Co., Inc., Fort Wayne, Ind.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
Lunkenheimer Co., The, Cincinnati, Ohio
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Manzel Brothers Co., Buffalo, N. Y.
Nathan Mfg. Co., 416 E. 106th St., New York City
Newman, Hender & Co., Ltd., Woodchester, England
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Swift Lubricator Co., Elmira, N. Y.
Torrington Mfg. Co., Inc., The, Torrington, Conn.

LUBRICATORS—Sight Feed:
Bowser, S. F., & Co., Inc., Fort Wayne, Ind.
Detroit Lubricator, 5900 Trumbull Ave., Detroit, Mich.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
Lunkenheimer Co., The, Cincinnati, Ohio
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Manzel Bros. Co., Buffalo, N. Y.
Nathan Mfg. Co., 416 E. 106th St., New York City
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Nugent, Wm. W., Co., 410 N. Hermitage, Chicago, Ill.
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.
Powell, Wm., Co., The, Cincinnati, Ohio
Swift Lubricator Co., Elmira, N. Y.

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MACHINES—Pipe-Cleaning—See PIPE CLEANING MACHINES:

MACHINES—Welding—See WELDERS, Electric Arc:

MAGNETOS:
American Bosch Corp., Springfield, Mass.
Apollo Magneto Corp., Kingston, N. Y.
Edison-Splitdirf Corp., West Orange, N. J.
Eisemann Magneto Corp., 60 E. 42nd St., New York City

Fairbanks, Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Scintilla Magneto Co., Inc., Sidney, N. Y.
Wico Electric Co., West Springfield, Mass.

MANHOLES—Tank and Vessel:
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Lenape Hydraulic Pressing & Forging Co., West Chester, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.
Mosher Steel Co., Houston, Tex.
Oxley Engineering Co., Ltd., London, England
Shand & Jurs Co., Berkeley, Calif.
Staytite Co., The, Houston, Tex.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vapor Recovery Systems Co., Compton, Calif.
Weber Engine Works, Kansas City, Mo.
Wyatt Metal & Boiler Works, Houston, Tex.

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Corning Glass Works, Corning, N. Y.
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International Filter Co., 325 W. 25th Place, Chicago, Ill.
King Engineering Corp., Ann Arbor, Mich.
Meriam Co., The, Cleveland, Ohio
Refinery Supply Co., Tulsa, Okla.
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Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Connelly Iron Sponge & Governor Co., 3154 S. California, Chicago, Ill.
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Bishinger-Koehler Manufacturing Co., Inc., 7838-42 Kelly St., Pittsburgh, Pa.
Boyer-Campbell Co., St. Antoine St., Detroit, Mich.
Bullard, E. D., Co., 275 8th St., San Francisco, Calif.
Davis Emergency Equipment Co., Inc., Newark, N. J.
General Tire & Rubber Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Greiner, Emil, Co., 55 Van Dam St., New York City
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Mine Safety Appliances Co., Pittsburgh, Pa.
Pulmosan Safety Equipment Co., Brooklyn, N. Y.

MEASURING TAPES—See TAPES, Measuring:

MECHANICAL TUBING—See TUBING, Mechanical:

MESH—Wire—See CLOTH, Wire:

METAL—Corrosion-Resisting—See ALLOYS, Corrosion-Resisting:

METALLIC FILTER CLOTH—See FILTER CLOTH, Metallic:

METER HOUSES—See HOUSES, Meter:

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Robinson Orifice Fitting Co., 1435 Santa Fe Ave., Los Angeles, Calif.

METERS—CO_2—See RECORDERS, CO_2:

METERS—Air:
American District Steam Co., North Tonawanda, N. Y.
American Meter Co., 60 East 42nd St., New York City
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Bristol Co., The Waterbury, Conn.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Fischer & Porter Co., Hatboro, Pa.
Foxboro Co., Foxboro, Mass.
Kent, Geo., Ltd., Luton, England
Mason-Neilan Regulator Co., Boston, Mass.
Meriam Co., The, Cleveland, Ohio
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.

METERS—Boiler:
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Foxboro Co., Foxboro, Mass.
Hays, A. M., Corp., Michigan City, Ind.
Henzzey Co., Watertown, Wis.
Kent, Geo., Ltd., Luton, England
Mason Neilan Regulator Co., Boston, Mass.
Neptune Meter Co., 50 W. 50th St., New York City
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.

METERS—Electric:
Bristol Co., The Waterbury, Conn.
Esterline Angus Co., Indianapolis, Ind.
Foxboro Co., Foxboro, Mass.
General Electric Co., Schenectady, N. Y.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Weston Electrical Instrument Corp., Newark, N. J.

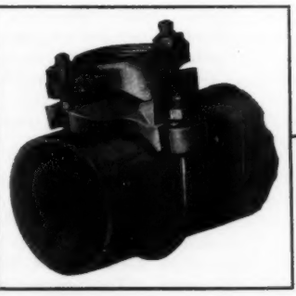
METERS—Flow:
American District Steam Co., North Tonawanda, N. Y.
American Meter Co., 60 East 42nd St., New York City
American Recording Chart Co., 3113 E. 11th St., Los Angeles, Calif.
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Bowser, S. F., & Co., Inc., Fort Wayne, Ind.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Fischer & Porter Co., Hatboro, Pa.
Foxboro Co., Foxboro, Mass.
Kent, Geo., Ltd., Luton, England
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Mason Neilan Regulator Co., Boston, Mass.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

METERS—Gas, Orifice-Type:
American District Steam Co., North Tonawanda, N. Y.
American Meter Co., 60 East 42nd St., New York City
American Recording Chart Co., 3113 E. 11th St., Los Angeles, Calif.
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Burke, Edmund, Engineering Co., 600 S. Michigan, Chicago, Ill.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Fischer & Porter Co., Hatboro, Pa.
Foxboro Co., Foxboro, Mass.
Kent, Geo., Ltd., Luton, England
Mason Neilan Regulator Co., Boston, Mass.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

METERS—Gasoline:
Bowser, S. F., & Co., Inc., Fort Wayne, Ind.
Brodie, Ralph N., Co., Oakland, Calif.
Buffalo Meter Co., Buffalo, N. Y.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Fischer & Porter Co., Hatboro, Pa.
Kent, Geo., Ltd., Luton, England
Neptune Meter Co., 50 W. 50th St., New York City
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
Smith Meter Co., Los Angeles, Calif.
Worthington Pump & Machinery Corp., Harrison, N. J.

METERS—Gas, Positive-Displacement Type:
American Meter Co., 60 East 42nd St., New York City
Brodie, Ralph N., Co., Oakland, Calif.
Foxboro Co., Foxboro, Mass.
Kent, Geo., Ltd., Luton, England
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Roots Connersville Blower Co., Connersville, Ind.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
Smith Meter Co., Los Angeles, Calif.
Sprague Meter Co., Bridgeport, Conn.

METERS—Orifice:
American District Steam Co., North Tonawanda, N. Y.
American Meter Co., 60 East 42nd St., New York City
American Recording Chart Co., 3113 E. 11th St., Los Angeles, Calif.
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Daniel Orifice Fitting Co., 3352 Union Pacific Ave., Los Angeles, Calif.
Fischer & Porter Co., Hatboro, Pa.
Foxboro Co., Foxboro, Mass.



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This new type saddle for oil and gas pipe lines facilitates accurate leveling of meters. It can be fitted to lines from 2" to 26" diameter by means of a U-bolt that fits into slots in the saddle body. These slots, in place of holes, insure easy removal even after the threads and nuts have rusted. The saddle permits exact leveling over a 14° angle. Indispensable for accurate metering.

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FOXBORO
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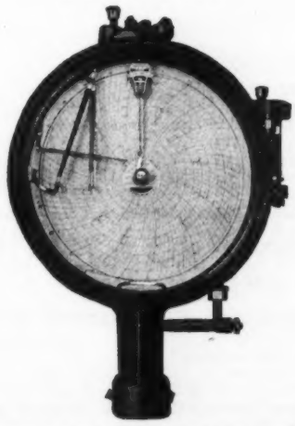
METERS



A complete line of Flow Meters for steam, gas, oil, water, solvents or other fluids. Orifice type . . . simple in design, powerful, with a straight-line motion that assures permanent calibration, long life. Can be furnished with integrator to give total flow. Recorders may also be equipped with pressure, temperature and integrator pens. Write for Bulletins No. 200-5 and 892. The Foxboro Company, 60 Neponset Ave., Foxboro, Mass., U. S. A.

Henzzey Co., Watertown, Wis.
Kent, Geo., Ltd., Luton, England
Mason Neilan Regulator Co., Boston, Mass.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.

METERS—Oil:
American Recording Chart Co., 3113 E. 11th St., Los Angeles, Calif.
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Bowser, S. F., & Co., Inc., Fort Wayne, Ind.
Brodie, Ralph N., Co., Oakland, Calif.
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Volumetric integrating type offer refinery advantages including:

- High-pressure steel casings
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- Extra—Simple Proven Design
- Moderate Cost

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Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Fischer & Porter Co., Hatboro, Pa.
Kent, Geo., Ltd., Luton, England
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Neptune Meter Co., 50 W. 50th St., New York City
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Roots Connersville Blower Co., Connersville, Ind.
Smith Meter Co., Los Angeles, Calif.
Worthington Pump & Machinery Corp., Harrison, N. J. City

METERS—Sight Flow:
Bowser, S. F., & Co., Inc., Fort Wayne, Ind.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Fischer & Porter Co., Hatboro, Pa.
Foxboro Co., Foxboro, Mass.

METERS—Water:
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Buffalo Meter Co., Buffalo, N. Y.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Fischer & Porter Co., Hatboro, Pa.
Foxboro Co., Foxboro, Mass.
Henzzey Co., Watertown, Wis.
Kent, Geo., Ltd., Luton, England
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Neptune Meter Co., 50 W. 50th St., New York City
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

MICROMETERS:
Brown & Sharpe Mfg. Co., Providence, R. I.
Lufkin Rule Co., Saginaw, Mich.

MIST EXTRACTORS—See EXTRACTORS, Mist:

MIXERS—Acid-Treating:
Alsop Engineering Co., Milldale, Conn.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, Ill.
Duriron Co., The, Inc., Dayton, Ohio
Eastern Engr. Co., New Haven, Conn.
Hendrick Mfg. Co., Carbondale, Pa.
Mixing Equipment Co., Inc., Rochester, N. Y.
Stratford Engineering Corp., Kansas City, Mo.

MIXERS—Continuous:
Mixing Equipment Co., Inc., Rochester, N. Y.

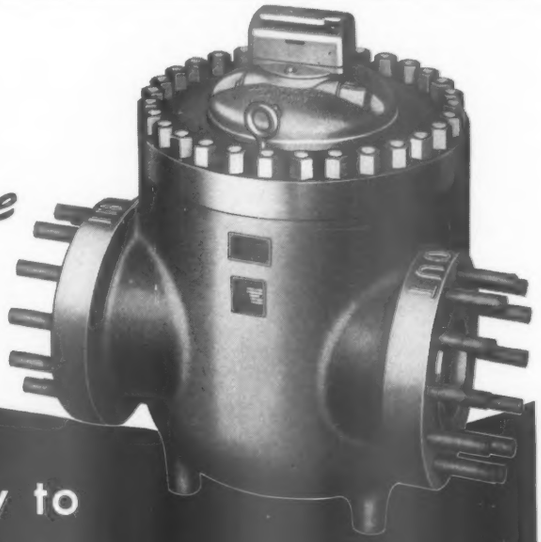
MIXERS—Liquid:
Alsop Engineering Co., Milldale, Conn.
Bowser, S. F., & Co., Inc., Fort Wayne, Ind.
Eastern Engr. Co., New Haven, Conn.
Hendrick Mfg. Co., Carbondale, Pa.
Lawrence Pump & Engine Co., Lawrence, Mass.
Mixing Equipment Co., Inc., Rochester, N. Y.
New England Tank & Tower Co., Everett, Mass.
Roy, Milton, Pumps, Chestnut Hill, Philadelphia, Pa.
Sarco Co., Inc., 475 5th Ave., New York City
Struthers-Wells Co., Div. of Struthers Wells-Titusville Corp., Warren, Pa.

MIXERS—Propeller-Type:
Alsop Engineering Co., Milldale, Conn.
American Steel Works, Kansas City, Mo.
American Well Works, Aurora, Ill.
Biggs Boiler Works, The, Akron, Ohio
Eastern Engr. Co., New Haven, Conn.
Lawrence Pump & Engine Co., Lawrence, Mass.
McNamar Boiler & Tank Co., Tulsa, Okla.
Mixing Equipment Co., Inc., Rochester, N. Y.
Morrison Brothers, Dubuque, Iowa
New England Tank & Tower Co., Everett, Mass.
Pfaudler Co., The, Rochester, N. Y.
Stratford Engineering Corp., Kansas City, Mo.
Struthers-Wells Co., Div. of Struthers Wells-Titusville Corp., Warren, Pa.
Wyatt Metal & Boiler Works, Houston, Tex.

MIXERS—Grease—See KETTLES:

MIXERS—Turbine-Type:
Abbe Engineering Co., 48 Church St., New York City
Acme Coppersmithing & Mach. Co., Philadelphia, Pa.
Blaw-Knox Co., Pittsburgh, Pa.
Dorr Co., Inc., 570 Lexington Ave., New York City
Eastern Engineering Co., New Haven, Conn.
Edge Moor Iron Works, Inc., 30 Rockefeller Plaza, New York City
Mixing Equipment Co., Inc., Rochester, N. Y.
New England Tank & Tower Co., 91 Tileston St., Everett, Mass.
Patterson Foundry & Machine Co., East Liverpool, Ohio
Struthers-Wells, Warren, Pa.
Treadwell Construction Co., Midland, Pa.
Turbo-Mixer Corp., 247 Park Ave., New York City

SMITH *High-Pressure* METERS



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IN refinery and pipe line service everywhere, Smith High-Pressure Meters have proved that they have the stamina to go on the line and *stay on stream.* Simplicity of design; freedom from heavy reciprocating parts, valves, and pistons; generous proportions which permit low rotor speeds—these and other qualities give Smith Meters their long life, freedom from wear, and sustained accuracy.

The exclusive, time-proved, Smith rotary-displacement principle gives Smith Meters a high degree of accuracy over wide ranges of flow. Because frictional resistance is negligible, pressures inside and outside the metering mechanism are always equalized. This eliminates possibility of distortion and inaccuracies due to pressure fluctuations. The entire metering mechanism can be removed without disturbing pipe line connections. This facilitates inspection and cleaning. It slashes replacement cost, too. After long service, only the inner metering mechanism need be renewed.

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SMITH METER Model M-65

Capacity: 650 gals. per min. 929 bbls. per hour. Working pressure: 1000 p.s.i. Nickel cast steel housing.

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Special equipment available includes: Automatic Temperature Correction, Remote Reading Register, Rate of Flow Indication, and special alloy construction to meet corrosive conditions.

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Smith High-Pressure Meters are made in three pressure ranges: 1000, 500, and 250 p.s.i., and in sizes from 57 to 929 bbls. per hour.

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MIXING KETTLES—See KETTLES, Mixing:

MIXING NOZZLES—See NOZZLES, Mixing:

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General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
LaClede Christy Clay Products Co., St. Louis, Mo.
Mexico Refractories Co., Mexico, Mo.
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Refractory & Insulation Corp., 381 4th Ave., New York City
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., The, 60 E. 42nd St., New York City

MORTAR—High-Temperature, Refractory:
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Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
LaClede Christy Clay Products Co., St. Louis, Mo.
Mexico Refractories Co., Mexico, Mo.
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Refractory & Insulation Corp., 381 Fourth Ave., New York City
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., The, 60 E. 42nd St., New York City

MOTOR-STARTING SWITCHES—See SWITCHES, Motor-Starting:

MOTORS—Air:
Airetool Mfg. Co., Springfield, Ohio
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Ingersoll-Rand Co., 11 Broadway, New York City
Key Co., East St. Louis, Ill.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

MOTORS—Electric, 1-Hp. and Larger:
Allis, Louis, Co., The, Milwaukee, Wis.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Century Electric Co., St. Louis, Mo.
Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.
Electric Machinery Mfg. Co., Minneapolis, Minn.
Elliott Co., Jeannette, Pa.
Fairbanks, Morse Co., 600 S. Michigan Ave., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Harnischfeger Corp., Milwaukee, Wis.
Ideal Electric & Mfg. Co., Mansfield, Ohio
Master Electric Co., Dayton, Ohio
Newman Industries, Ltd., Bristol, England
Robbins & Myers, Inc., Springfield, Ohio
Sturtevant, B. F., Hyde Park, Boston, Mass.
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOTORS—Electric, Fractional Horsepower:
Century Electric Co., St. Louis, Mo.
General Electric Co., Schenectady, N. Y.
Master Electric Co., Dayton, Ohio
Newman Industries, Ltd., Bristol, England
Pioneer Gen-E-Motor Corp., 466 W. Superior, Chicago, Ill.
Robbins & Myers, Inc., Springfield, Ohio
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Speedway Mfg. Co., Cicero, Ill.
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOTORS—Explosion Proof:
Allis, Louis, Co., The, Milwaukee, Wis.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Century Electric Co., St. Louis, Mo.
Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Harnischfeger Corp., Milwaukee, Wis.
Ideal Electric & Mfg. Co., Mansfield, Ohio
Master Electric Co., Dayton, Ohio
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOTORS—Splashproof:
Allis, Louis, Co., The, Milwaukee, Wis.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Century Electric Co., St. Louis, Mo.
Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Harnischfeger Corp., Milwaukee, Wis.
Ideal Electric & Mfg. Co., Mansfield, Ohio
Master Electric Co., Dayton, Ohio
Newman Industries, Ltd., Bristol, England
Robbins & Myers, Inc., Springfield, Ohio
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOTORS—Totally Enclosed:
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Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Century Electric Co., St. Louis, Mo.
Elliott Co., Jeannette, Pa.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Harnischfeger Corp., Milwaukee, Wis.
Ideal Electric & Mfg. Co., Mansfield, Ohio
Master Electric Co., Dayton, Ohio
Newman Industries, Ltd., Bristol, England
Robbins & Myers, Inc., Springfield, Ohio
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MUFFLERS—Exhaust—See SILENCERS, Exhaust:

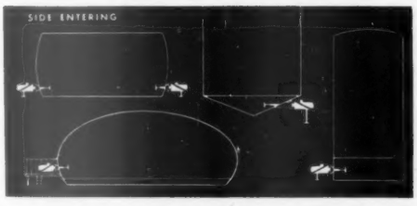
MULTIPLE V-BELTS—See BELTS, Multiple-V:

NATURAL GAS POLYMERIZATION—See PROCESSES. Refinery:

NECKS—Welding:
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Lenape Hydraulic Pressing & Forging Co., West Chester, Pa.
Limbert, George B., Co., 570 Fulton, Chicago, Ill.
Midwest Piping & Supply Co., St. Louis, Mo.
Taylor Forge & Pipe Works, Cicero, Ill.
Texas Pipe Bending Co., Houston, Tex.
Walworth Co., 60 E. 42nd St., New York City

NONSPARKING TOOLS—See TOOLS, Nonsparking, Safety:

NOZZLES—Mixing:
Duriron Co., The, Inc., Dayton, Ohio
Haveg Corp., Newark, Del.
Spray Engineering Co., Somerville, Mass.



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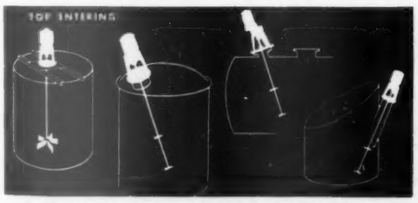

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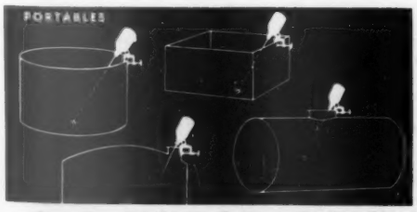

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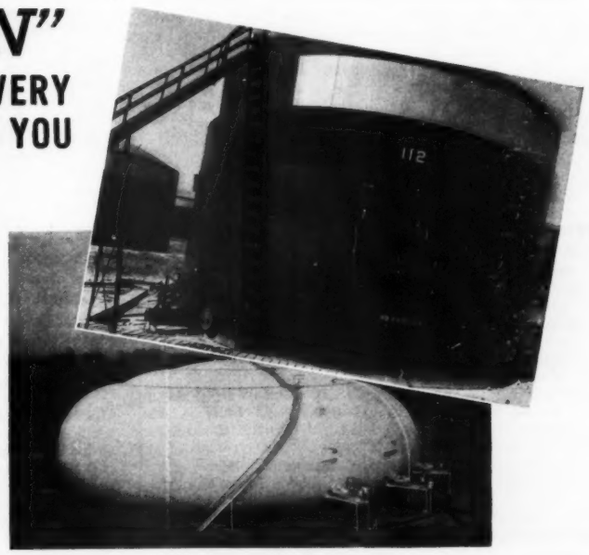

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Haveg Corp., Newark, Del.
Hudson Engineering Co., Houston, Tex.
Link Belt Co., 307 N. Michigan Ave., Chicago, Ill.
Marley Co., The, Kansas City, Kans.
National Airoil Burner Co., 1284 E. Sedgley Ave., Philadelphia, Pa.
Rockwood Sprinkler Co., Worcester, Mass.
Schubert-Christy Corp., Affton Station, St. Louis, Mo.
Schutte & Koerting Co., 1116 Thompson St., Philadelphia Pa.
Spray Engineering Co., Somerville, Mass.
Spraying Systems Co., 4021 W. Lake, Chicago, Ill.
Walker, W. L., Co., Tulsa, Okla.
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

NOZZLES—Tank and Vessel, Forged-Steel:
Lenape Hydraulic Pressing & Forging Co., West Chester, Pa.
Staytite Co., The, Houston, Tex.
Taylor Forge & Pipe Works, Cicero, Ill.
Vapor Recovery Systems Co., Compton, Calif.

NUTS:
Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Nut & Bolt Co., Inc., Bridgeport, Conn.
Erie Bolt & Nut Co., Erie, Pa.
Hadfields Limited, London, Eng.
Lamson & Sessions Co., 1971 W. 85th St., Cleveland, Ohio
Oliver Iron & Steel Corp., 1001 Muriel St., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Sheffield Steel Corp., Kansas City, Mo.
Victor Products Corp., 2631 Belmont, Chicago, Ill.

NUTS—Alloy-Steel:
Bethlehem Steel Co., Bethlehem, Pa.
Duriron Co., The, Inc., Dayton, Ohio
Erie Bolt & Nut Co., Erie, Pa.
Hadfields Limited, London, Eng.
Lamson & Sessions Co., 1971 W. 85th St., Cleveland, Ohio
Ohio Steel Foundry Co., The, Springfield, Ohio
Oliver Iron & Steel Corp., 1001 Muriel St., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Sheffield Steel Corp., Kansas City, Mo.
Victor Products Corp., 2631 Belmont, Chicago, Ill.

NUTS—Brass or Bronze:
Ampco Metals, Inc., Milwaukee, Wis.
Erie Bolt & Nut Co., Erie, Pa.
Gilbert Brass Foundry Co., St. Louis, Mo.
Saginaw Bearing Co., Saginaw, Mich.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Victor Products Corp., 2631 Belmont, Chicago, Ill.

NUTS—Lock:
Automatic Nut Co., Inc., Lebanon, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Nut & Bolt Co., Inc., Bridgeport, Conn.
Elastic Stop Nut Corp., Union, N. J.
Erie Bolt & Nut Co., Erie, Pa.
Laminated Shim Co., Inc., Glenbrook, Conn.
Lamson & Sessions Co., 1971 W. 85th St., Cleveland, Ohio
Oliver Iron & Steel Corp., 1001 Muriel St., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Security Metal Products, Inc., Saugatuck, Mich.
Standard Pressed Steel Co., Jenkintown, Philadelphia, Pa.

OIL-TESTING INSTRUMENTS:
Greiner, Emil, Co., 55 Van Dam St., New York City
King Refrigeration Co., 1011 Jefferson Ave., Toledo, Ohio
Podbielniak Centrifugal Super-Contractor Co., 8312 S. Chicago, Chicago, Ill.
Precision Scientific Co., 1750 N. Springfield, Chicago, Ill.
Refinery Supply Co., Tulsa, Okla.
Schaar & Co., 754 W. Lexington, Chicago, Ill.
Spencer Lens Co., Buffalo, N. Y.
Standard Electric Time Co., Springfield, Mass.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.

OIL BURNERS—See BURNERS, Oil:

OIL CUPS—See CUPS, Oil:

OIL METERS—See METERS, Oil:

OIL THIEFS—See THIEFS, Oil:

OIL PURIFIERS—See PURIFIERS, Oil:

OIL SEALS—See SEALS, Oil:

OPTICAL PYROMETERS—See PYROMETERS:

ORIFICE FITTINGS:
American Meter Co., 60 East 42nd St., New York City
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Daniel Orifice Fitting Co., 3352 Union Pacific Ave., Los Angeles, Calif.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Robinson Orifice Fitting Co., 1435 Santa Fe Ave., Los Angeles, Calif.
Taylor Instrument Companies, Rochester, N. Y.

ORIFICE FLANGES—See FLANGES, Orifice:

ORIFICE METERS—See METERS, Orifice:

ORIFICE PLATES—See ORIFICE FITTINGS:

ORIFICES:
American Meter Co., 60 East 42nd St., New York City
Bristol Co., The, Waterbury, Conn.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Daniel Orifice Fitting Co., 3352 Union Pacific Ave., Los Angeles, Calif.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Taylor Instrument Companies, Rochester, N. Y.

PACKING—Asbestos:
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
British Belting & Asbestos, Ltd., Yorkshire, England
Carey, Philip, Co., The, Cincinnati, Ohio
Carlyle Rubber Co., 64 Park Place, New York City
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Durabla Mfg. Co., 114 Liberty St., New York City
Durametallic Co., Kalamazoo, Mich.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Gatke Corp., 228 N. La Salle St., Chicago, Ill.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodyear Tire & Rubber Co., Akron, Ohio
Greene, Tweed & Co., 101 Park Ave., New York City
Hewitt Rubber Corp., Buffalo, N. Y.
Jenkins Brothers, 80 White St., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Mattison Co., Ambler, Pa.
Klingerit, Inc., 16 Hudson St., New York City
Linear Packing & Rubber Co., Inc., Philadelphia, Pa.
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.
Packing Engineering Corp., Cranford, N. J.
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Thermoid Co., Trenton, N. J.
Union Asbestos & Rubber Co., Cicero, Ill.
U. S. Rubber Co., 1230 6th Ave., New York City
Vellumoid Co., Worcester, Mass.

PACKING—Cloth-Inserted:
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Carlyle Rubber Co., 64 Park Place, New York City
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 6th Ave., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Greene, Tweed & Co., 101 Park Ave., New York City
Hewitt Rubber Corp., Buffalo, N. Y.
Jenkins Brothers, 80 White St., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Linear Packing & Rubber Co., Inc., Philadelphia, Pa.
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 6th Ave., New York City

PACKING—Fiber:
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 6th Ave., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Greene, Tweed & Co., 101 Park Ave., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Linear Packing & Rubber Co., Inc., Philadelphia, Pa.
Maloney, F. H., Co., Houston, Tex.
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 Sixth Ave., New York City
Vellumoid Co., Worcester, Mass.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

PACKING—Hot-Oil, Pump:
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Belting Co., 125 N. Green, Chicago, Ill.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Durabla Mfg. Co., 114 Liberty St., New York City
Durametallic Corp., Kalamazoo, Mich.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Greene, Tweed & Co., 101 Park Ave., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Linear Packing & Rubber Co., Inc., Philadelphia, Pa.
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.
National Engineering Products, Inc., Washington, D. C.
Packing Engineering Corp., Cranford, N. J.
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 Sixth Ave., New York City

PACKING—Leather:
Alexander Brothers, Inc., 405 N. Third St., Philadelphia, Pa.
Auer, C. L. and W. W., Corry, Pa.
Chicago Belting Co., 125 N. Green, Chicago, Ill.
Durametallic Corp., Kalamazoo, Mich.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Excelsior Leather Washer Co., Rockford, Ill.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Graton & Knight Mfg. Co., Worcester, Mass.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Houghton, E. F., Co., Third, American and Somerset Sts., Philadelphia, Pa.
Preston, Horace G., Co., 2581 Beecher St., Detroit, Mich.
Rhoads, J. E., & Sons, 35 N. Sixth St., Philadelphia, Pa.
Schieren, Charles A., Co., 30 Ferry St., New York City

PACKING—Mechanical Seal—See SEALS, Oil:

PACKING—Metallic:
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Cook, C. Lee, Mfg. Co., Inc., Louisville, Ky.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Durametallic Corp., Kalamazoo, Mich.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
France Manufacturing Co., Belgrade St., Philadelphia, Pa.
France Packing Co., Tacony, Philadelphia, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Koppers Co., Koppers Bldg., Pittsburgh, Pa.
National Engineering Products, Inc., Washington, D. C.
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
U. S. Rubber Co., 1230 Sixth Ave., New York City

PACKING—Molded:
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Belting Co., 125 N. Green, Chicago, Ill.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Greene, Tweed & Co., 101 Park Ave., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Linear Packing & Rubber Co., Inc., Philadelphia, Pa.
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.
U. S. Rubber Co., 1230 Sixth Ave., New York City

PACKING—Plastic:
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Durametallic Corp., Kalamazoo, Mich.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Haveg Corp., Newark, Del.
Johns-Manville Corp., 22 E. 40th St., New York City
Linear Packing & Rubber Co., Inc., Philadelphia, Pa.
Maloney, F. H., Co., Houston, Tex.
National Engineering Products, Inc.,Washington, D. C.
Packing Engineering Corp., Cranford, N. J.
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Reilly Tar & Chemical Co., Indianapolis, Ind.
U. S. Rubber Co., 1230 Sixth Ave., New York City

PACKING—Rubber:
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Belting Co., 125 N. Green, Chicago, Ill.
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
General Tire & Rubber Co., Akron, Ohio
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Hewitt Rubber Corp., Buffalo, N. Y.
Jenkins Brothers, 80 White St., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Linear Packing & Rubber Co., Inc., Philadelphia, Pa.
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.
New York Rubber Corp., 9 Rockefeller Plaza, New York City
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 Sixth Ave., New York City
Westinghouse Air Brake Co., Wilmerding, Pa.

PACKING—Semimetallic:
Belmont Packing & Rubber Co., Butler and Sepviva, Philadelphia, Pa.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Durabla Mfg. Co., 114 Liberty St., New York City
Durametallic Corp., Kalamazoo, Mich.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Klingerit, Inc., 16 Hudson St., New York City
Linear Packing & Rubber Co., Inc., Philadelphia, Pa.
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.
National Engineering Products, Inc.,Washington, D. C.
Packing Engineering Corp., Cranford, N. J.
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.

PACKING—Sheet:
Belmont Packing & Rubber Co., Butler and Sepviva, Philadelphia, Pa.
Carlyle Rubber Co., 64 Park Place, New York City
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Durabla Mfg. Co., 114 Liberty St., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Gatke Corp., 228 N. La Salle St., Chicago, Ill.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Greene, Tweed & Co., 101 Park Ave., New York City
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Hewitt Rubber Corp., Buffalo, N. Y.
Jenkins Brothers, 80 White St., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Linear Packing & Rubber Co., Inc., Philadelphia, Pa.
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 Sixth Ave., New York City
Vellumoid Co., Worcester, Mass.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

PACKING TOWER—See TOWER, Packing:

PAINTS:
Acme White Lead & Color Works, 8250 St. Aubin, Detroit, Mich.
Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
American-Marietta Co., 43 E. Ohio, Chicago, Ill.
Arco Co., 7301 Bessemer Ave., Cleveland, Ohio
Chipman Chemical Co., Inc., Bound Brook, N. J.
Du Pont de Nemours, E. I., & Co., Inc., Wilmington, Del.
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Horn, A. C., Co., Houston, Tex.

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Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa.
Quigley Co., Inc., 56 W. 45th St., New York City
Reilly Tar & Chemical Co., Indianapolis, Ind.
Rust-Oleum Corp., 1928 W. Grand Ave., Chicago, Ill.
Sherwin-Williams Co., The, Midland Bank Bldg., Cleveland, Ohio
Skybryte Co., 3125 Perkins Ave., Cleveland, Ohio
Steel Protection & Chemical Co., Inc., Mooresville, Ind.
Sullivan Co., The, Memphis, Tenn.

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Wailes-Dove Hermiston Corp., Westfield, N. J.

PANELBOARDS—See SWITCHBOARDS, Electric:

PAINTS—Heat-Resistant:
Acme White Lead & Color Works, 8250 St. Aubin, Detroit, Mich.
Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
Aluminum Industries, Inc., Cincinnati, Ohio
American-Marietta Co., 43 E. Ohio, Chicago, Ill.
Arco Co., 7301 Bessemer Ave., Cleveland, Ohio
Chipman Chemical Co., Inc., Bound Brook, N. J.
Horn, A. C., Co., Houston, Tex.
Koppers Co., Koppers Bldg., Pittsburgh, Pa.
Lucas, Robert M., Co., 1955 W. 31st St., Chicago, Ill.
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Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa.
Quigley Co., Inc., 56 W. 45th St., New York City
Reilly Tar & Chemical Co., Indianapolis, Ind.
Rust-Oleum Corp., 1928 W. Grand Ave., Chicago, Ill.
Sherwin-Williams Co., The, Midland Bldg., Cleveland, Ohio
Skybryte Co., 3125 Perkins Ave., Cleveland, Ohio
Sullivan Co., The, Memphis, Tenn.
Tnemec Co., Inc., Kansas City, Mo.
Truscon Laboratories, Inc., The, Caniff & G.T.R.R., Detroit, Mich.
Wailes-Dove Hermiston Corp., Westfield, N. J.

PAINT GUNS:
Alexander Milburn Co., Baltimore, Md.
Horn, A. C., Co., Houston, Tex.
Metallizing Co. of America, Inc., 562 W. Washington Blvd., Chicago, Ill.
Metallizing Engr. Co., Inc., 2107 41st Ave., Long Island City, N. Y.
Spray Engineering Co., Somerville, Mass.

PENSTOCKS:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Goslin Birmingham Mfg. Co., Inc., 350 Madison Ave., New York City
Graver Tank & Mfg. Co., 4809 Todd, East Chicago, Ind.
Humble Oil & Refining Co., Houston, Tex.
Lancaster Iron Works, Lancaster, Pa.
Mosher Steel Co., Houston, Tex.
Wyatt Metal & Boiler Works, Houston, Tex.

PILING:
American Creosoting Co., Louisville, Ky.
American Rolling Mill Co., The, Middletown, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Lancaster Iron Works, Lancaster, Pa.
National Tube Co., Box 266, Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
South Chester Tube Co., Chester, Pa.
Texas Creosoting Co., Orange, Tex.

PIPE—Alloy:
Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
American Brass Co., 25 Broadway, New York City
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Blaw-Knox Co., Blawnox, Pa.
Burgess-Parr Co., Freeport, Ill.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Haynes Stellite Co., Kokomo, Ind.
Kellogg Co., M. W., 225 Broadway, New York City
National Supply Co., Toledo, Ohio
National Tube Co., Box 266, Pittsburgh, Pa.
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Republic Steel Corp., Republic Bldg., Cleveland, Ohio
Revere Copper & Brass, Inc., 230 Park Ave., New York City
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Texas Pipe Bending Co., Houston, Tex.
Walworth Co., 60 E. 42nd St., New York City
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

PIPE—Asbestos and Cement:
Carey, Philip, Co., The, Cincinnati, Ohio
Johns-Manville Corp., 22 E. 40th St., New York City

PIPE BENDS:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Biggs Boiler Works, The, Akron, Ohio
Burke, Edmund, Engineering Co., 600 S. Michigan Ave., Chicago, Ill.
Cast Iron Pipe Research Assn., 122 S. Michigan Ave., Chicago, Ill.
Clow, James B., & Sons, 201 N. Talman, Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Frick Co., Waynesboro, Pa.

Harrisburg Steel Corp., Harrisburg, Pa.
Limbert, George B., Co., 570 Fulton, Chicago, Ill.
Kellogg Co., M. W., 225 Broadway, New York City
Midwest Piping & Supply Co., St. Louis, Mo.
National Valve & Mfg. Co., 3101 Liberty Ave., Pittsburgh, Pa.
Pittsburgh Piping & Equipment Co., Pittsburgh, Pa.
South Chester Tube Co., Chester, Pa.
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PIPE-JOINT COMPOUNDS—See COMPOUNDS, Pipe-Joint:

PIPE—Brass:
American Brass Co., 25 Broadway, New York City
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Foster Wheeler Corp., 6 Church St., New York City
Gilbert Brass Foundry Co., St. Louis, Mo.
Revere Copper & Brass, Inc., 230 Park Ave., New York City
Wolverine Tube Co., 1411 Central Ave., Detroit, Mich.

PIPE—Butt-Welded:
Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
LaClede Steel Co., St. Louis, Mo.
Lancaster Iron Works, Lancaster, Pa.
Limbert, George B., 570 Fulton, Chicago, Ill.
National Supply Co., Toledo, Ohio
National Tube Co., Box 266, Pittsburgh, Pa.
Stewarts & Lloyds, Ltd., Glasgow, Scotland
Republic Steel Corp., Republic Bldg., Cleveland, Ohio
South Chester Tube Co., Chester, Pa.
Spang Chalfant, Inc., Pittsburgh, Pa.
Texas Pipe Bending Co., Houston, Tex.
Wheeling Steel Corp., Wheeling, W. Va.
Wyatt Metal & Boiler Works, Houston, Tex.
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

PIPE—Cast-Iron:
American Cast Iron Pipe Co., Birmingham, Ala.
Cast Iron Pipe Research Assn., 122 S. Michigan Ave., Chicago, Ill.
Central Foundry Co., 386 Fourth Ave., New York City
Clow, James B., & Sons, 201 N. Talman, Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
McWane Cast Iron Pipe Co., Birmingham, Ala.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Pittsburgh Piping & Equipment Co., Pittsburgh, Pa.
U. S. Pipe & Foundry Co., Burlington, N. J.
Walworth Co., 60 E. 42nd St., New York City

PIPE—Cement-Lined:
American Cast Iron Pipe Co., Birmingham, Ala.
Cast Iron Pipe Research Assn., 122 S. Michigan Ave., Chicago, Ill.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
National Tube Co., Box 266, Pittsburgh, Pa.
Naylor Pipe Co., 1232 E. 92nd St., Chicago, Ill.
U. S. Pipe & Foundry Co., Burlington, N. J.
Walworth Co., 60 E. 42nd St., New York City

PIPE-CLEANING MACHINES:
Airetool Mfg. Co., Springfield, Ohio
Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, Ill.
W-K-M Co., Inc., Houston, Tex.

PIPE COILS:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
American Cast Iron Pipe Co., Birmingham, Ala.
Burke, Edmund, Engineering Co., 600 S. Michigan Ave., Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Frick Co., Waynesboro, Pa.
Harrisburg Steel Corp., Harrisburg, Pa.
Limbert, George B., Co., 570 Fulton, Chicago, Ill.
Midwest Piping & Supply Co., St. Louis, Mo.
National Lead Co., 111 Broadway, New York, N. Y.
National Valve & Mfg. Co., 3101 Liberty Ave., Pittsburgh, Pa.
Oxley Eng. Co., Ltd., London, England
South Chester Tube Co., Chester, Pa.
Stewarts & Lloyds, Inc., Glasgow, Scotland
Texas Pipe Bending Co., Houston, Tex.
Vogt, Henry, Machine Co., Louisville, Ky.
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Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio
Blaw-Knox Co., Blawnox, Pa.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Dempster Mill Mfg. Co., Beatrice, Neb.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Graver Tank & Mfg. Co., 4809 Todd, East Chicago, Ind.
Lancaster Iron Works, Lancaster, Pa.
McWane Cast Iron Pipe Co.
National Supply Co., Toledo, Ohio
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Republic Steel Corp., Republic Bldg., Cleveland, Ohio
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Smith, A. O., Corp., Milwaukee, Wis.
Taylor Forge & Pipe Works, Cicero, Ill.
Texas Pipe Bending Co., Houston, Tex.
Vulcan Steel Tank Corp., Tulsa, Okla.
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Blaw-Knox Co., Blawnox, Pa.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Limbert, George B., Co., 570 Fulton, Chicago, Ill.
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Pittsburgh Piping & Equipment Co., Pittsburgh, Pa.
Republic Steel Corp., Republic Bldg., Cleveland, Ohio
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Spang Chalfant, Inc., Pittsburgh, Pa.
Stewarts & Lloyds, Inc., Glasgow, Scotland
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Wheeling Steel Corp., Wheeling, W. Va.
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PIPE REAMERS—See REAMERS, Pipe:

PIPE SADDLES—See SADDLES, Pipe:

PIPE—Seamless Steel:
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Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Globe Steel Tubes Co., Milwaukee, Wis.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Limbert, George B., Co., 570 Fulton, Chicago, Ill.
National Supply Co., Toledo, Ohio
National Tube Co., Box 266, Pittsburgh, Pa.
Pittsburgh Piping & Equipment Co., Pittsburgh, Pa.
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
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Texas Pipe Bending Co., Houston, Tex.
Timken Roller Bearing Co. (Steel and Tube Div.), Canton, Ohio
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

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Taylor Forge & Pipe Works, Cicero, Ill.

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PLANTS—Oil-Refining—See PROCESSES, Refinery:

PLANTS, Polymerization—See PROCESSES, Refinery:

PLANTS—Topping and Vacuum—See PROCESSES, Refinery:

PLANTS—Viscosity-Breaking—See PROCESSES, Refinery:

PLASTIC FIRE BRICK—See BRICK, Fire, Plastic:

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PLUG VALVES—See VALVES, Plug:

PNEUMATIC GRINDERS—See GRINDERS, Pneumatic:

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Limbert, George B., Co., 570 Fulton, Chicago, Ill.
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Hudson Engineering Co., Houston, Tex.
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PROCESSES, Catalytic Desulfurization—See PROCESSES, Desulfurization:

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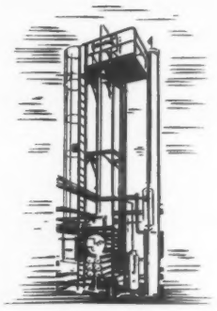

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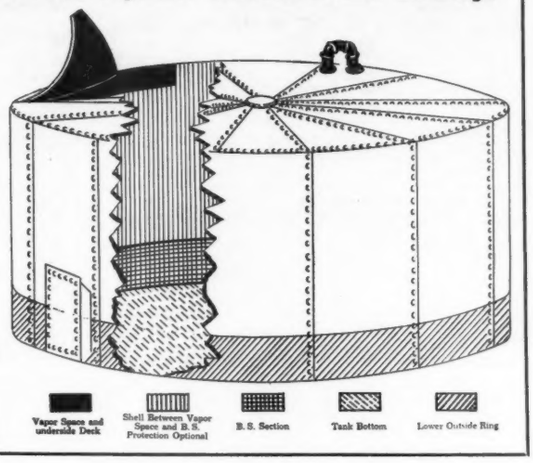
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Viking Pump Co., Cedar Falls, Iowa.
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Wallace & Tiernan Co., Belleville, N. J.
Weir, G. & J., Ltd., Glasgow, Scotland
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Asphalt:
Aeroil Burner Co., Inc., 561 Park Ave., West New York, N. J.
Dayton Dowd Co., Quincy, Ill.
Dean Brothers Pumps, Inc., Indianapolis, Ind.
Foster Pump Works, Inc., 50 Washington St., Brooklyn, N. Y.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Kinney Mfg. Co., 3529-41 Washington St., Boston, Mass.
Leyman Mfg. Corp., Cincinnati, Ohio
National Transit Pump & Machine Co., Oil City, Pa.
Oil Well Supply Co., Dallas, Tex.
Quimby Pump Co., Inc., Newark, N. J.
Roots Connersville Blower Co., Connersville, Ind.
Roper, George D., Corp., Rockford, Ill.
Roy, Milton, Pumps, Chestnut Hill, Philadelphia, Pa.
Union Steam Pump Co., Battle Creek, Mich.
Viking Pump Co., Cedar Falls, Iowa
Weir, G. & J., Ltd., Glasgow, Scotland
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Boiler-Feed Water:
Aldrich Pump Co., Allentown, Pa.
Allen, W. H., Sons & Co., Ltd., Bedford, England
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Steam Pump Co., Battle Creek, Mich.
Aurora Pump Co., Aurora, Ill.
Bird Archer Co., 2030 N. Natchez Ave., Chicago, Ill.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Dayton Dowd Co., Quincy, Ill.
Dean Brothers Pumps, Inc., Indianapolis, Ind.
Dean Hill Pump Co., Anderson, Ind.
DeLaval Steam Turbine Co., Trenton, N. J.
Deming Co., The, Salem, Ohio
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Frederick Iron & Steel Co., Frederick, Md.
Gardner Denver Co., Quincy, Ill.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Haering, D. W., & Co., 205 W. Wacker Drive, Chicago, Ill.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City
Lawrence Pump & Engine Co., Lawrence, Mass.
Lecourtenay Co., Newark, N. J.
Leyman Mfg. Corp., Cincinnati, Ohio
Manistee Iron Works, Manistee, Mich.
Micro-Westco, Inc., Bettendorf, Iowa
National Steam Pump Co., Upper Sandusky, Ohio
National Transit Pump & Machine Co., Oil City, Pa.
Oil Well Supply Co., Dallas, Tex.
Pacific Pump Works, 5715 Bickett St., Huntington Park, Calif.
Sterling Pump Co., Hamilton, Ohio
Union Steam Pump Co., Battle Creek, Mich.
Watson-Stillman Co., Fitting Div., Roselle, N. J.
Weir, G. & J., Ltd., Glasgow, Scotland
Wilson-Snyder Mfg. Div. of Oil Well Supply Co., Braddock, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Brine:
Allen, W. H., Sons & Co., Ltd., Bedford, England
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Steam Pump Co., Battle Creek, Mich.
Aurora Pump Co., Aurora, Ill.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Dayton Dowd Co., Quincy, Ill.
Dean Brothers Pumps, Inc., Indianapolis, Ind.
Dean Hill Pump Co., Anderson, Ind.
DeLaval Steam Turbine Co., Trenton, N. J.
Eastern Engr. Co., New Haven, Conn.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Frederick Iron & Steel Co., Frederick, Md.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City
Lawrence Pump & Engine Co., Lawrence, Mass.
Lecourtenay Co., Newark, N. J.
Leyman Manufacturing Corp., Cincinnati, Ohio
Manistee Iron Works, Manistee, Mich.
Micro-Westco, Inc., Bettendorf, Iowa
National Steam Pump Co., Upper Sandusky, Ohio
National Transit Pump & Machine Co., Oil City, Pa.
Oil Well Supply Co., Dallas, Tex.
Oliver United Filters, Inc., 33 W. 42nd St., New York City
Quimby Pump Co., Inc., Newark, N. J.
Roper, George D., Corp., Rockford, Ill.
Sterling Pump Co., Hamilton, Ohio
Union Steam Pump Co., Battle Creek, Mich.
Viking Pump Co., Cedar Falls, Iowa
Weir, G. & J., Ltd., Glasgow, Scotland
Wheatley Brothers, Tulsa, Okla.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Centrifugal:
Aldrich Pump Co., Allentown, Pa.
Allen, W. H., Sons & Co., Ltd., Bedford, England
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Alsop Engineering Co., Milldale, Conn.
American Manganese Steel Co., 389 E. 114h St., Chicago Heights, Ill.
American Steam Pump Co., Battle Creek, Mich.
American Well Works, Aurora, Ill.
Aurora Pump Co., Aurora, Ill.
Barnes Manufacturing Co., Mansfield, Ohio
Beach-Russ Co., 50 Church St., New York City
Brown & Sharpe Mfg. Co., Providence, R. I.
Buffalo Pumps, Inc., Buffalo, N. Y.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Dayton Dowd Co., Quincy, Ill.
Dean Brothers Pumps, Inc., Indianapolis, Ind.
Dean Hill Pump Co., Anderson, Ind.
DeLaval Steam Turbine Co., Trenton, N. J.
Deming Co., The, Salem, Ohio
Dempster Mill Mfg. Co., Beatrice, Neb.
Domestic Engine & Pump Co., Shippensburg, Pa.
Eastern Engr. Co., New Haven, Conn.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Frederick Iron & Steel Co., Frederick, Md.
Gardner Denver Co., Quincy, Ill.
Gorman-Rupp Pump Co., Mansfield, Ohio
Goulds Pumps, Inc., Seneca Falls, N. Y.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
Homelite Corp., Port Chester, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City

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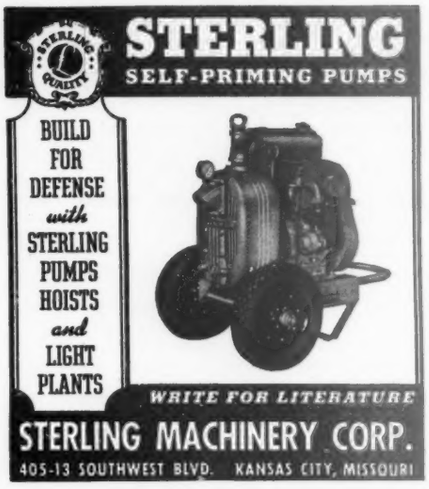
National Carbon Co., Inc., Cleveland, Ohio
National Steam Pump Co., Upper Sandusky, Ohio
Novo Engine Co., Lansing, Mich.
Oil Well Supply Co., Dallas, Tex.
Oliver United Filters, Inc., 33 W. 42nd St., New York City
Pacific Pump Works, 5715 Bickett St., Huntington Park, Calif.

Pioneer Gen-E-Motor Corp., 466 W. Superior, Chicago, Ill.
Quimby Pump Co., Inc., Newark, N. J.
Smith, A. O., Corp., Milwaukee, Wis.
Smith Meter Co., Los Angeles, Calif.
Sterling Machinery Corp., Kansas City, Mo.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Wilfley & Sons, Inc., A. R., Denver, Colo.
Wilson-Snyder Mfg. Div. of Oil Well Supply Co., Braddock, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Chemical:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Alsop Engineering Co., Milldale, Conn.
American Manganese Steel Co., 389 E. 14th St., Chicago Heights, Ill.
American Steam Pump Co., Battle Creek, Mich.
Aurora Pump Co., Aurora, Ill.
Beach-Russ Co., 50 Church St., New York City
Bird Archer Co., 2030 N. Natchez Ave., Chicago, Ill.
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Buffalo Pumps, Inc., Buffalo, N. Y.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Dayton Dowd Co., Quincy, Ill.
Eastern Engr. Co., New Haven, Conn.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Foster Pump Works, Inc., 50 Washington St., Brooklyn, N. Y.
Frederick Iron & Steel Co., Frederick, Md.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Haering, D. W., & Co., 205 W. Wacker Drive, Chicago, Ill.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City
Lawrence Pump & Engine Co., Lawrence, Mass.
Leyman Manufacturing Corp., Cincinnati, Ohio
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Manzel Bros. Co., Buffalo, N. Y.
Micro-Westco, Inc., Bettendorf, Iowa
Nash Engr. Co., South Norwalk, Conn.
National Carbon Co., Inc., Cleveland, Ohio
National Transit Pump & Machine Co., Oil City, Pa.
Oliver United Filters, Inc., 33 W. 42nd St., New York City
%Proportioneers, Inc.%, Providence, R. I.
Quimby Pump Co., Inc., Newark, N. J.
Roper, George D., Corp., Rockford, Ill.
Roy, Milton, Pumps, Chestnut Hill, Philadelphia, Pa.
Sterling Pump Co., Hamilton, Ohio
Union Steam Pump Co., Battle Creek, Mich.
U. S. Stoneware Co., The, 60 E. 42nd St., New York City
Wallace & Tiernan Co., Belleville, N. J.
Wheatley Brothers, Tulsa, Okla.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Clay Handling:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Dayton Dowd Co., Quincy, Ill.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Micro-Westco, Inc., Bettendorf, Iowa
Robbins & Myers, Inc., Springfield, Ohio
Union Steam Pump Co., Battle Creek, Mich.

PUMPS, Deep Well—See PUMPS, Turbine, Deep Well:

PUMPS—Diaphragm:
Barnes Manufacturing Co., Mansfield, Ohio
Deming Co., The, Salem, Ohio
Domestic Engine & Pump Co., Shippensburg, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goulds Pumps, Inc., Seneca Falls, N. Y.
Newman, Hender & Co., Ltd., Woodchester, England
Novo Engine Co., Lansing, Mich.
Oliver United Filters, Inc., 33 W. 42nd St., New York City
Wallace & Tiernan Co., Belleville, N. J.

PUMPS—Hot Oil:
Amerdican Manganese Steel Co., 389 E. 14th St., Chicago Heights, Ill.
American Steam Pump Co., Battle Creek, Mich.
Aurora Pump Co., Aurora, Ill.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Dayton Dowd Co., Quincy, Ill.
Dean Brothers Pumps, Inc., Indianapolis, Ind.
Dean Hill Pump Co., Anderson, Ind.
DeLaval Steam Turbine Co., Trenton, N. J.
Deming Co., The, Salem, Ohio
Goulds Pumps, Inc., Seneca Falls, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City
Lecourtenay Co., Newark, N. J.
Leyman Manufacturing Corp., Cincinnati, Ohio
Micro-Westco, Inc., Bettendorf, Iowa
National Steam Pump Co., Upper Sandusky, Ohio
National Transit Pump & Machine Co., Oil City, Pa.
Oil Well Supply Co., Dallas, Tex.
Pacific Pump Works, 5715 Bickett St., Huntington Park, Calif.
Prescott Co., The, Menominee, Mich.
Roper, George D., Corp., Rockford, Ill.
Smith, A. O., Corp., Milwaukee, Wis.
Union Steam Pump Co., Battle Creek, Mich.
Weir, G. & J., Ltd., Glasgow, Scotland
Wilson-Snyder Mfg. Div. of Oil Well Supply Co., Braddock, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Plunger:
Aldrich Pump Co., Allentown, Pa.
American Steam Pump Co., Battle Creek, Mich.
Barnes Manufacturing Co., Mansfield, Ohio
Dean Brothers Pumps, Inc., Indianapolis, Ind.
Deming Co., The, Salem, Ohio
Domestic Engine & Pump Co., Shippensburg, Pa.
Excelsior Leather Washer Co., Rockford, Ill.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Gorman-Rupp Pump Co., Mansfield, Ohio
Goulds Pumps, Inc., Seneca Falls, N. Y.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City
Leyman Manufacturing Corp., Cincinnati, Ohio
National Steam Pump Co., Upper Sandusky, Ohio
National Transit Pump & Machine Co., Oil City, Pa.
Novo Engine Co., Lansing, Mich.
Oil Well Supply Co., Dallas, Tex.
Prescott Co., The, Nenominee, Mich.
%Proportioneers, Inc.%, Providence, R. I.
Roy, Milton, Pumps, Chestnut Hill, Philadelphia, Pa.
Union Steam Pump Co., Battle Creek, Mich.
Weir, G. & J., Ltd., Glasgow, Scotland
Wheland Co., Chattanooga, Tenn.
Wilson-Snyder Mfg. Div. of Oil Well Supply Co., Braddock, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Power:
Aldrich Pump Co., Allentown, Pa.
American Steam Pump Co., Battle Creek, Mich.
Barnes Manufacturing Co., Mansfield, Ohio
Brown & Sharpe Mfg. Co., Providence, R. I.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Dean Brothers Pumps, Inc., Indianapolis, Ind.
DeLaval Steam Turbine Co., Trenton, N. J.
Deming Co., The, Salem, Ohio
Domestic Engine & Pump Co., Shippensburg, Pa.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Foster Pump Works, Inc., 50 Washington St., Brooklyn, N. Y.
Gardner Denver Co., Quincy, Ill.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City
Kinney Mfg. Co., 3529-41 Washington St., Boston, Mass.
Lawrence Pump & Engine Co., Lawrence, Mass.
Leyman Manufacturing Corp., Cincinnati, Ohio
Micro-Westco, Inc., Bettendorf, Iowa
National Steam Pump Co., Upper Sandusky, Ohio
National Supply Co., Toledo, Ohio
National Transit Pump & Machine Co., Oil City, Pa.
Novo Engine Co., Lansing, Mich.
Oil Well Supply Co., Dallas, Tex.
Roper, George D., Corp., Rockford, Ill.
Sterling Machinery Corp., Kansas City, Mo.
Sterling Pump Co., Hamilton, Ohio
Union Steam Pump Co., Battle Creek, Mich.
Viking Pump Co., Cedar Falls, Iowa
Weir, G. & J., Ltd., Glasgow, Scotland
Wheatley Brothers, Tulsa, Okla.
Wheland Co., Chattanooga, Tenn.
Wilson-Snyder Mfg. Div. of Oil Well Supply Co., Braddock, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Proportioning:
Aldrich Pump Co., Allentown, Pa.
American Steam Pump Co., Battle Creek, Mich.
Betz, W. H. & L. D., Frankford, Philadelphia, Pa.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, Ill.
Eastern Engr. Co., New Haven, Conn.
Elgin Softener Corp., Elgin, Ill.
Haering, D. W., & Co., 205 W. Wacker Drive, Chicago, Ill.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
International Filter Co., 325 W. 25th St., Chicago, Ill.
Manzel Bros. Co., Buffalo, N. Y.
National Transit Pump & Machine Co., Oil City, Pa.
Oil Well Supply Co., Dallas, Tex.
Oliver United Filters, Inc., 33 W. 42nd St., New York City
%Proportioneers, Inc.%, Providence, R. I.
Roy, Milton, Pumps, Chestnut Hill, Philadelphia, Pa.
Union Steam Pump Co., Battle Creek, Mich.
Wallace & Tiernan Co., Belleville, N. J.

PUMPS—Reciprocating:
Aldrich Pump Co., Allentown, Pa.
American Steam Pump Co., Battle Creek, Mich.
Barnes Manufacturing Co., Mansfield, Ohio
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Dean Brothers Pumps, Inc., Indianapolis, Ind.
Deming Co., The, Salem, Ohio
Domestic Engine & Pump Co., Shippensburg, Pa.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Gardner Denver Co., Quincy, Ill.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City
Leyman Manufacturing Corp., Cincinnati, Ohio
McDonald, A. Y., Mfg. Co., 12th and Pine, Dubuque, Iowa
National Steam Pump Co., Upper Sandusky, Ohio
National Transit Pump & Machine Co., Oil City, Pa.
Novo Engine Co., Lansing, Mich.
Oil Well Supply Co., Dallas, Tex.
Prescott Co., The, Menominee, Mich.
Roy, Milton, Pumps, Chestnut Hill, Philadelphia, Pa.
Union Steam Pump Co., Battle Creek, Mich.
Weir, G. & J., Ltd., Glasgow, Scotland
Wheatley Brothers, Tulsa, Okla.
Wheland Co., Chattanooga, Tenn.
Wilson-Snyder Mfg. Div. of Oil Well Supply Co., Braddock, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Rotary:
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Dayton Dowd Co., Quincy, Ill.
DeLaval Steam Turbine Co., Trenton, N. J.
Deming Co., The, Salem, Ohio
Eastern Engr. Co., New Haven, Conn.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Foster Pump Works, Inc., 50 Washington St., Brooklyn, N. Y.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City
Kinney Mfg. Co., 3529-41 Washington St., Boston Mass.
Kraissl Co., Inc., The Hackensack, N. J.
McDonald, A. Y., Mfg. Co., 12th and Pine, Dubuque Iowa
Nash Engr. Co., South Norwalk, Conn.
National Transit Pump & Machine Co., Oil City, Pa.
Oil Well Supply Co., Dallas, Tex.
Prescott Co., The, Menominee, Mich.
Quimby Pump Co., Inc., Newark, N. J.
Robbins & Myers, Inc., Springfield, Ohio
Roots Connersville Blower Co., Connersville, Ind.
Roper, George D., Corp., Rockford, Ill.
Viking Pump Co., Cedar Falls, Iowa
Weir, G. & J., Ltd., Glasgow, Scotland
Worthington Pump & Machinery Corp., Harrison, N. J

PUMPS—Semirotary, Wing Type:
Newman, Hender & Co., Ltd., Woodchester, England

PUMPS—Screw:
Aurora Pump Co., Aurora, Ill.
Dayton Dowd Co., Quincy, Ill.
DeLaval Steam Turbine Co., Trenton, N. J.
Quimby Pump Co., Inc., Newark, N. J.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Submersible, Electric Centrifugal:
Aldrich Pump Co., Allentown, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

American Manganese Steel Co., 389 E. 14th St., Chicago Heights, Ill.
American Steam Pump Co., Battle Creek, Mich.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Dean Hill Pump Co., Anderson, Ind.
DeLaval Steam Turbine Co., Trenton, N. J.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Lawrence Pump & Engine Co., Lawrence, Mass.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Suction:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Manganese Steel Co., 389 E. 14th St., Chicago Heights, Ill.
American Steam Pump Co., Battle Creek, Mich.
Aurora Pump Co., Aurora, Ill.
Barnes Manufacturing Co., Mansfield, Ohio
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Deming Co., The, Salem, Ohio
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City
Kinney Mfg. Co., 3529-41 Washington St., Boston, Mass.
Leyman Manufacturing Corp., Cincinnati, Ohio
Micro-Westco, Inc., Bettendorf, Iowa
Nash Engr. Co., South Norwalk, Conn.
National Transit Pump & Machine Co., Oil City, Pa.
Oil Well Supply Co., Dallas, Tex.
Prescott Co., The, Menominee, Mich.
Roper, George D., Corp., Rockford, Ill.
Sterling Machinery Corp., Kansas City, Mo.
Union Steam Pump Co., Battle Creek, Mich.
Weir, G. & J., Ltd., Glasgow, England

PUMPS—Tar:
American Steam Pump Co., Battle Creek, Mich.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Dean Brothers Pumps, Inc., Indianapolis, Ind.
Foster Pump Works, Inc., 50 Washington St., Brooklyn, N. Y.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Kinney Mfg. Co., 3529-41 Washington St., Boston, Mass.
Leyman Manufacturing Corp., Cincinnati, Ohio
National Transit Pump & Machine Co., Oil City, Pa.
Oil Well Supply Co., Dallas, Tex.
Quimby Pump Co., Inc., Newark, N. J.
Roots Connersville Blower Co., Connersville, Ind.
Roper, George D., Corp., Rockford, Ill.
Union Steam Pump Co., Battle Creek, Mich.
Viking Pump Co., Cedar Falls, Iowa
Weir, G. & J., Ltd., Glasgow, Scotland
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Triplex:
Aldrich Pump Co., Allentown, Pa.
American Steam Pump Co., Battle Creek, Mich.
Clark Bros. Co., Box 560, Olean, N. Y.
Dean Brothers Pumps, Inc., Indianapolis, Ind.
Deming Co., The, Salem, Ohio
Domestic Engine & Pump Co., Shippensburg, Pa.
Gorman-Rupp Pump Co., Mansfield, Ohio
Goulds Pumps, Inc., Seneca Falls, N. Y.
National Transit Pump & Machine Co., Oil City, Pa.
Oil Well Supply Co., Dallas, Tex.
Prescott Co., The, Menominee, Mich.
Union Steam Pump Co., Battle Creek, Mich.
Weir, G. & J., Ltd., Glasgow, Scotland
Wheatley Brothers, Tulsa, Okla.
Wilson-Snyder Mfg. Div. of Oil Well Supply Co., Braddock, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Turbine, Deep Well:
Allen, W. H., Sons & Co., Ltd., Bedford, England
American Well Works, Aurora, Ill.
Aurora Pump Co., Aurora, Ill.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Cook, A. D., Inc., Lawrenceburg, Ind.
Deming Co., The, Salem, Ohio
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Layne & Bowler, Inc., Memphis, Tenn.
Pacific Pump Works, 5715 Bickett St., Huntington Park, Calif.
Sterling Pump Co., Hamilton, Ohio
Weir, G. & J., Ltd., Glasgow, Scotland
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Vacuum:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Steam Pump Co., Battle Creek, Mich..
Beach-Russ Co., 50 Church St., New York City
Bury Compressor Co., Erie, Pa.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Clark Bros. Co., Box 560, Olean, N. Y.
Croll-Reynolds Engineering Co., 17 John St., New York City
Dean Brothers Pumps, Inc., Indianapolis, Ind.
Devine, J. P., Manufacturing Co., Mount Vernon, Ill.
Foster Pump Works, Inc., 50 Washington St., Brooklyn, N. Y.
Foster Wheeler Corp., 6 Church St., New York City
Fuller Co., Catasauqua, Pa.
Gardner Denver Co., Quincy, Ill.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Ingersoll-Rand Co., 11 Broadway, New York City
Kinney Mfg. Co., 3529-41 Washington St., Boston, Mass.
Leyman Manufacturing Corp., Cincinnati, Ohio
Nash Engr. Co., South Norwalk, Conn.
National Steam Pump Co., Upper Sandusky, Ohio
Oil Well Supply Co., Dallas, Tex.
Precision Scientific Co., 1750 N. Springfield Ave., Chicago, Ill.
Prescott Co., The, Menominee, Mich.
Roots Connersville Blower Co., Connersville, Ind.
Sullivan Machinery Co., Michigan City, Ind.
Tokheim Co., Cedar Rapids, Iowa
Union Steam Pump Co., Battle Creek, Mich.
Weir, G. & J., Ltd., Glasgow, Scotland
Worthington Pump & Machinery Corp., Harrison, N. J.

PURIFIERS—Oil:
Briggs Clarifier Co., 3262 K St., N. W., Washington, D. C.
DeLaval Steam Turbine Co., Trenton, N. J.
De Luxe Products Corp., La Porte, Ind.
Hagan Corp., 300 Ross St., Pittsburgh, Pa.
Hilliard Corp., The, Elmira, N. Y.
Honan Crane Corp., Lebanon, Ind.
Nugent, Wm. W., Co., 410 N. Hermitage, Chicago, Ill.
Petroleum Engineering, Inc., Tulsa, Okla.
Skinner Purifiers, Inc., 1349 East Milwaukee, Detroit, Mich.
Youngstown Miller Co., Sandusky, Ohio

PYROMETERS:
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Cambridge Instrument Co., Inc., 3732 Grand Central Terminal, New York City
Englehard, Charles, Inc., Newark, N. J.
Foxboro Co., Foxboro, Mass.

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RASCHIG RINGS—See TOWER PACKING:

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Foxboro Co., Foxboro, Mass.
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Mason Neilan Regulator Co., Boston, Mass.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.

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Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Esterline Angus Co., Indianapolis, Ind.
Foxboro Co., Foxboro, Mass.
General Electric Co., Schenectady, N. Y.

Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.

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Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Fischer & Porter Co., Hatboro, Pa.
Foxboro Co., Foxboro, Mass.
Henzzey Co., Watertown, Wis.
Kent, Geo., Ltd., Bedfordshire, England
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Mason Neilan Regulator Co., Boston, Mass.
Neumann Bros., 150 Lafayette St., New York City
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
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Taylor Instrument Companies, Rochester, N. Y.

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Mason Neilan Regulator Co., Boston, Mass.
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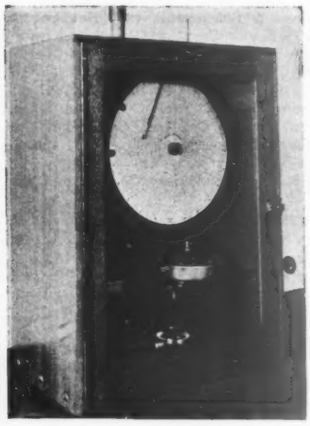
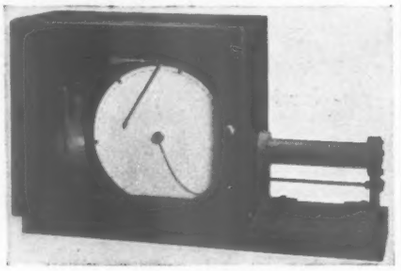


Right: Arcco-Anubis Recording Liquid Gravitometer.

Left: Arcco-Anubis Recording Gas Gravitometer.



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REFINERY PROCESSES—See PROCESSES, Refinery:

REFRACTORIES—See Specific Products:

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Green, A. P., Fire Brick Co., Mexico, Mo.
Harbison-Walker Refractories Co., 1800 Farmers Bank Bldg., Pittsburgh, Pa.
Johns-Manville, 22 E. 40th St., New York City
Kellogg, M. W., Co., The, 225 Broadway, New York City
LaClede-Christy Clay Products Co., St. Louis, Mo.
Mexico Refractories Co., Mexico, Mo.
Norton Co., Worcester, Mass.
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REFRACTORY CEMENT—See CEMENT, Refractory

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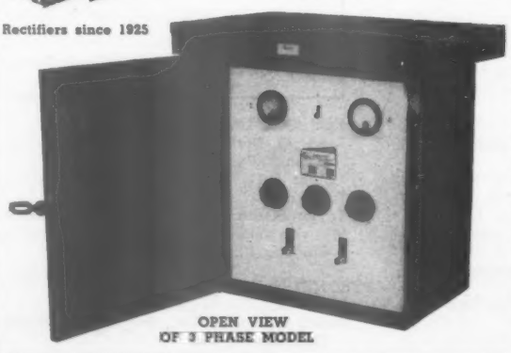

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REGULATORS—Back Pressure:
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Northern Equipment Co., Erie, Pa.
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Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio
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Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

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Taylor Instrument Companies, Rochester, N. Y.
Webster Engineering Co., Tulsa, Okla.

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Hagan Corp., 300 Ross St., Pittsburgh, Pa.
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Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Mueller Co., Decatur, Ill.
National Airoil Burner Co., 1284 E. Sedgley Ave., Philadelphia, Pa.
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REGULATORS—Liquid Level—See CONTROLLERS, Liquid Level:

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Inferno Co., Shreveport, La.
Kieley & Mueller, Inc., 40 W. 13th St., New York City
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Mason Neilan Regulator Co., Boston, Mass.
Penn Electric Switch Co., Goshen, Ind.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Reynolds Gas Regulator Co., Anderson, Ind.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.

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Linde Air Products Co., The, 30 E. 42nd St., New York City
Modern Engineering Co., St. Louis, Mo.
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Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.

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Clark Controller Co., 1146 E. 152nd St., Cleveland, Ohio
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Kieley & Mueller, Inc., 40 W. 13th St., New York City

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McDonnel & Miller, Wrigley Bldg., Chicago, Ill.
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Vapor Recovery Systems Co., Compton, Calif.
Webster Engineering Co., Tulsa, Okla.
Wheelco Instruments Co., Harrison and Peoria Sts, Chicago, Ill.

REGULATORS—Pressure Reducing:
Acme Regulator Co., Tulsa, Okla.
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland Ohio
Birch Manufacturing Co., 1521 Sedgwick St., Chicago, Ill.
Cash, A. W., Co., Decatur, Ill.
Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.
Connelly Iron Sponge & Governor Co., 3154 S. California, Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Foster Engineering Co., Newark, N. J.
Fulton Sylphon Co., The, Knoxville, Tenn.
Grove Regulator Co., Oakland, Calif.
Hagan Corp., 300 Ross St., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kieley & Mueller, Inc., 40 W. 13th St., New York City
Leslie Co., Lyndhurst, N. J.
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
Modern Engineering Co., St. Louis, Mo.
Mueller Co., Decatur, Ill.
Natural Gas Equipment, Inc., 714 W. Olympic Blvd., Los Angeles, Calif.
Northern Equipment Co., Erie, Pa.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Reynolds Gas Regulator Co., Anderson, Ind.
Ruggles Klingemann Mfg. Co., Salem, Mass.
Spence Engineering Co., Inc., Walden, N. Y.
Squires, C. E., Co., 3934 Kelly Ave., Cleveland, Ohio
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Vapor Recovery Systems Co., Compton, Calif.
Webster Engineering Co., Tulsa, Okla.

REGULATORS—Pump—See GOVERNORS, Pump

REGULATORS—Steam Pressure—See REGULATORS, Pressure

REGULATORS—Temperature—See CONTROLLERS, Temperature

REGULATORS—Vacuum:
Cash, A. W., Co., Decatur, Ill.
Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.
Cutler Hammer, Inc., Milwaukee, Wis.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Foster Engineering Co., Newark, N. J.
Foxboro Co., Foxboro, Mass.
Greiner, Emil, Co., 55 Van Dam St., New York City
Hagan Corp., 300 Ross St., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kieley & Mueller, Inc., 40 W. 13th St., New York City
Mason-Neilan Regulator Co., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Natural Gas Equipment, Inc., 714 W. Olympic Blvd., Los Angeles, Calif.
Penn Electric Switch Co., Goshen, Ind.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Reynolds Gas Regulator Co., Anderson, Ind.
Shand & Jurs Co., Berkeley, Calif.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Vapor Recovery Systems Co., Compton, Calif.

REGULATORS—Vapor Recovery:
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Foxboro Co., Foxboro, Mass.
Hanlon-Waters, Inc., Tulsa, Okla.
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
Natural Gas Equipment, Inc., 714 W. Olympic Blvd., Los Angeles, Calif.
Shand & Jurs Co., Berkeley, Calif.
Vapor Recovery Systems Co., Compton, Calif.

REGULATORS—Voltage:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Clark Controller Co., 1146 E. 152nd St., Cleveland, Ohio
Electric Machinery Mfg. Co., Minneapolis, Minn.

General Electric Co., Schenectady, N. Y.
Simplex Corp., East Moline, Ill.

RELAYS—Electric:
American Automatic Electric Sales Co., 1033 W. Van Buren, Chicago, Ill.
Automatic Switch Co., 41 E. 11th St., New York City
Bradley, Allen, Milwaukee, Wis.
Clark Controller Co., 1146 E. 152nd St., Cleveland, Ohio
Cutler Hammer, Inc., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Greiner, Emil, Co., 55 Van Dam St., New York City
Guardian Electric Co., 1623 W. Walnut St., Chicago, Ill.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Nelson Electric Mfg. Co., Tulsa, Okla.
Penn Electric Switch Co., Goshen, Ind.
Square D Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Westin Electrical Instrument Corp., Newark, N. J.

RESPIRATORS:
American Optical Co., Southbridge, Mass.
Boyer-Campbell Co., 6540 St. Antoine St., Detroit, Mich.
Goggle Parts Co., The, Century Bldg., Cleveland, Ohio
Goodrich, B. F., Co., Akron, Ohio
Industrial Products Co., 2828 N. 4th St., Philadelphia, Pa.
Mine Safety Appliances Co., Pittsburgh, Pa.
Sellstrom Mfg. Co., 615 N. Aberdeen, Chicago, Ill.

RETORTS:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bethlehem Foundry & Machine Co., Bethlehem, Pa.
Lancaster Iron Works, Lancaster, Pa.
Ohio Steel Foundry Co., The, Springfield, Ohio

RETURN BENDS—See BENDS, Return

RETURN BENDS—Welding—See FITTINGS, Welding

RETURN HEADERS—See HEADERS, Return

ROCK WOOL—See INSULATION, Rock Wool

RODS—Brass or Bronze, all Shapes:
American Brass Co., 25 Broadway, New York City
Champion Rivet Co., The, E. 108th St. and Harvard Ave., Cleveland, Ohio
Gilbert Brass Foundry Co., St. Louis, Mo.
Saginaw Bearing Co., Saginaw, Mich.
Scovill Mfg. Co., Waterbury, Conn.

RODS—Welding, see WELDING ELECTRODES and RODS

ROOFING MATERIALS:
Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
American-Marietta Co., 43 E. Ohio, Chicago, Ill.
Asbestos & Engineering Products, Ltd., London, England
Carey, Philip, Co., The, Cincinnati, Ohio.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City.
Keasbey & Mattison Co., Ambler, Pa.
Koppers Co., Koppers Bldg., Pittsburgh, Pa.
Lucas, Robert M., Co., 1955 West 31st St., Chicago, Ill.
Myers, A. M., Co., Box 83, Pittsburgh, Pa.
Protective Coatings, Inc., 10391 Northlawn, Detroit, Mich.
Reilly Tar & Chemical Co., Indianapolis, Ind.
Ruberoid Co., 500 Fifth Ave., New York City.
Sullivan Co., The, Memphis, Tenn.
Tnemec Co., Inc., Kansas City, Mo.
Truscon Steel Co., Youngstown, Ohio.

ROOFING—Corrugated Asbestos:
Asbestos & Engineering Products, Ltd., London, England
Carey, Philip, Co., The, Cincinnati, Ohio.
Johns-Manville Corp., 22 E. 40th St., New York City.
Keasbey & Mattison Co., Ambler, Pa.
Ruberoid Co., 500 Fifth Ave., New York City.

ROOFS—Breather:
Chicago Bridge & Iron Co., 332 S. Michigan, Chicago, Ill.

ROOFS—Floating:
Chicago Bridge & Iron Co., 332 S. Michigan, Chicago, Ill.

ROOFS—Furnace:
Bigelow-Liptak Corp., 2842 W. Grand Blvd., Detroit, Mich.
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
LaClede Christy Clay Products Co., St. Louis, Mo.
Sullivan Co., The, Memphis, Tenn.

ROPE WIRE—See WIRE ROPE

ROTAMETERS:
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Fischer & Porter Co., Hatboro, Pa.
Schutte & Koerting Co., 1116 Thompson St., Philadelphia, Pa.

ROTARY PUMPS—See PUMPS, Rotary

RULES—Aluminum:
Lufkin Rule Co., Saginaw, Mich.

RULES—Measuring, Wood:
Jarecki Mfg. Co., St. Louis, Mo.
Lufkin Rule Co., Saginaw, Mich.
Stanley Tools, The Stanley Works, New Britain, Conn.

RULES—Steel, Measuring:
Brown & Sharpe Mfg. Co., Providence, R. I.
Keuffel & Esser Co., Hoboken, N. J.
Lufkin Rule Co., Saginaw, Mich.
Stanley Tools, The Stanley Works, New Britain, Conn.
Starrett, L. S., Co., Athol, Mass.

SADDLES—Meter-Leveling—See METER LEVELING, Saddles

SAFETY BELTS—See BELTS, Safety

SAFETY EQUIPMENT—See Specific Products

SAFETY HEADS:
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SAFETY SHOES—See SHOES, Safety Toe

SALT-EXTRACTION PLANTS—See PLANTS, Desalting:

SADDLES—Pipe:

American District Steam Co., N. Tonawanda, N. Y.
Clow, James B., & Sons, 201 N. Talman, Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Dresser Mfg. Co., Bradford, Pa.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Hadfields, Ltd., London, England
Jarecki Mfg. Co., St. Louis, Mo.
McNamar Boiler & Tank Co., Tulsa, Okla.
Midwest Piping & Supply Co., St. Louis, Mo.
National Machine Works, 1559 North Sheffield, Chicago, Ill.
National Valve & Mfg. Co., 3101 Liberty Ave., Pittsburgh, Pa.
Oil Well Supply Co., Dallas, Tex.
Skinner, M. B., Co., South Bend, Ind.
Taylor Forge & Pipe Works, Cicero, Ill.
Texas Pipe Bending Co., Houston, Tex.
Walworth Co., 60 East 42 St., New York City.
Wheatley Brothers, Tulsa, Okla.

SAMPLERS—Oil, Crude-Oil:

Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Greiner, Emil, Co., 55 Van Dam Street, New York City.
%Proportioneers, Inc.%, Providence, R. I.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Vapor Recovery Systems Co., Compton, Calif.

SCALE-REMOVING CHEMICALS—See CHEMICALS Scale-Removing

SCALES—Fluid-Pressure—See GAUGE-TESTING EQUIPMENT

SCREENS—Clay-Tower:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Audubon Wire Cloth Corp., Castor Ave. and Richmond St., Philadelphia, Pa.
Cambridge Wire Cloth Co., Cambridge, Md.
Michigan Wire Cloth Co., 2080 Howard, Detroit, Mich.
Multi-Metal Wire Cloth Co., Inc., Bronx, New York City
Newark Wire Cloth Co., Newark, N. J.

SCREENS—Filter:

Audubon Wire Cloth Corp., Castor Ave. and Richmond St., Philadelphia, Pa.
Cambridge Wire Cloth Co., Cambridge, Md.
Michigan Wire Cloth Co., 2080 Howard, Detroit, Mich.
Newark Wire Cloth Co., Newark, N. J.
Tyler, W. S., Co., 3615 Superior Ave., Cleveland, Ohio.

SCREENS—Wire:

Audubon Wire Cloth Corp., Castor Ave., and Richmond St., Philadelphia, Pa.
Cambridge Wire Cloth Co., Cambridge, Md.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Michigan Wire Cloth Co., 2080 Howard, Detroit, Mich.
Multi-Metal Wire Cloth Co., Inc., Bronx, New York City.
Newark Wire Cloth Co., Newark, N. J.
Tyler, W. S., Co., 3615 Superior Ave., Cleveland, Ohio.

SCREWS—Cap:

Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Bristol Co., The, Waterbury, Conn.
Lamson & Sessions Co., 1971 W. 85th St., Cleveland, Ohio.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Sheffield Steel Corp., Kansas City, Mo.
Standard Pressed Steel Co., Jenkintown, Philadelphia, Pa.
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio.

SCREWS—Machine:

Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
Lamson & Sessions Co., 1971 W. 85th St., Cleveland, Ohio.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Scovill Mfg. Co., Waterbury, Conn.
Sheffield Steel Corp., Kansas City, Mo.
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio.

SCREWS—Set:

Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Bristol Co., The, Waterbury, Conn.
Lamson & Sessions Co., 1971 W. 85th St., Cleveland, Ohio.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Sheffield Steel Corp., Kansas City, Mo.
Standard Pressed Steel Co., Jenkintown, Philadelphia, Pa.
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio.

SCRUBBERS—Gas:

American Locomotive Co., Alco Products Div., 30 Church St., New York City
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Fluor Corp., Ltd., Box 7030, Los Angeles, Calif.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Hanlon-Waters, Inc., Tulsa, Okla.
Hudson Engineering Co., Houston, Tex.
Knight, Maurice A., Akron, Ohio.
Lancaster Iron Works, Lancaster, Pa.
National Carbon Co., Inc., Cleveland, Ohio
National Radiator Corp., Johnstown, Pa.
Oil Well Supply Co., Dallas, Tex.
Peabody Engineering Corp., 580 Fifth Ave., New York City
Stearns-Roger Mfg. Co., Denver, Colo.
Vulcan Steel Tank Corp., Tulsa, Okla.
Wyatt Metal & Boiler Works, Houston, Tex.

SEALS—Oil:

Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Econo-Vent Corp., 1005 Belmont, Chicago, Ill.
Garlock Packing Co., Palmyra, N. Y.
Graton & Knight Mfg. Co., Worcester, Mass.
Johns-Manville Corp., 22 E. 40th St., New York City
National Carbon Co., Inc., Cleveland, Ohio
Saginaw Bearing Co., Saginaw, Mich.
Sullivan Co., The, Memphis, Tenn.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

SECTIONAL CONDENSERS—See CONDENSERS, Sectional

SEPARATORS—Acid Sludge:

Biggs Boiler Works, The, Akron, Ohio.
DeLaval Separator Co., 165 Broadway, New York City.

SEPARATORS—Centrifugal:

Hagan Corp., 300 Ross St., Pittsburgh, Pa.
Jersey Dairy Equipment Co., Inc., Bloomfield, N. J.
Logan Engineering Co., Lawrence and Lamson Aves., Chicago, Ill.
Sharples Corp., 23rd and Westmoreland Sts., Philadelphia, Pa.
Struthers-Wells Co. (Div. of Struthers Wells-Titusville Corp.), Warren, Pa.

SEPARATORS—Oil and Gas:

Biggs Boiler Works, Akron, Ohio.
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Burt Tank, Separator & Oil Treating Corp., Wichita Falls, Tex.
Central Foundry Co., 386 4th Ave., New York City.
Centrifix Corp., 3029 Prospect Ave., Cleveland, Ohio.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Gato Valve Co., 1430 Oliver Bldg., Pittsburgh, Pa.
Hagan Corp., 300 Ross St., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Hudson Engineering Co., Houston, Tex.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kieley & Mueller, Inc., 40 W. 13th St., New York City.
McNamar Boiler & Tank Co., Tulsa, Okla.
M & V Tank Co., Wichita Falls, Tex.
Muskegon Boiler Works, Muskegon, Mich.
National Radiator Corp., Johnstown, Pa.
Hudson Engineering Co., Houston, Tex.
National Tank Co., Tulsa, Okla.
Smith, A. O., Corp., Milwaukee, Wis.
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio.
Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio.
Vulcan Steel Tank Corp., Tulsa, Okla.
Wyatt Metal & Boiler Works, Houston, Tex.

SEPARATORS—Steam:

Babcock & Wilcox Co., The, 85 Liberty St., New York City
Biggs Boiler Works, The, Akron, Ohio.
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Centrifix Corp., 3029 Prospect Ave., Cleveland, Ohio.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Elliott Co., Jeannette, Pa.
Fisher Governor Co., Marshalltown, Iowa
Gato Valve Co., 1430 Oliver Bldg., Pittsburgh, Pa.
Hagan Corp., 300 Ross St., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
International Filter Co., 325 W. 25th Place, Chicago, Ill.
Kieley & Mueller, Inc., 40 W. 13th St., New York City.
McAlear Manufacturing Co., 1901 S. Western Ave., Chicago, Ill.
National Valve & Mfg. Co., 3101 Liberty Ave., Pittsburgh, Pa.
Nicholson, W. H., & Co., Wilkes Barre, Pa.
Sims Co., The, Erie, Pa.
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio.
Struthers-Wells Co. (Div. of Struthers Wells-Titusville Corp.), Warren, Pa.
Swartwout Co., The 18511 Euclid Ave., Cleveland, Ohio.
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

SERVICE—Instrument-Repair—See INSTRUMENT REPAIR SERVICE

SEPTIC TANKS:

American Steel Works, Kansas City, Mo.
American Well Works, Aurora, Ill.
Butler Mfg. Co., Kansas City, Mo.
Dickey, W. S., Clay Mfg. Co., Kansas City, Mo.
Lancaster Iron Works, Lancaster, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.

SET SCREWS—See SCREWS, Set

SHEETS—Asbestos and Cement:

Asbestos & Engineering Products, Ltd., London, England
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Matteson Co., Ambler, Pa.
Ruberoid Co., 500 5th Ave., New York City.

SHIELDS—Welding:

Air Reduction Sales Co., 60 E. 42nd St., New York City
Bullard, E. D., Co., 275 8th St., San Francisco, Calif.
General Electric Co., Schenectady, N. Y.
Goggle Parts Co., The, Century Building, Cleveland, Ohio.
Good-All Electric Mfg. Co., Ogallala, Neb.
Industrial Products Co., 2828 N. 4th St., Philadelphia, Pa.
Mine Safety Appliances Co., Pittsburgh, Pa.
National Cylinder Gas Co., 205 W. Wacker, Chicago, Ill.
Sellstrom Mfg. Co., 615 N. Aberdeen, Chicago, Ill.
Wilson Welder & Metals Co., Inc., 60 E. 42 St., New York City.

SHINGLES—See ROOFING MATERIALS

SHOES—Safety Toe:

Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
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Mine Safety Appliances Co., Pittsburgh, Pa.
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Harnischfeger Corp., Milwaukee, Wis.

Jeffrey Mfg. Co., The, Columbus, Ohio.
Lima Locomotive Works, Inc., Lima, Ohio
Link Belt Co., 307 N. Michigan Ave., Chicago, Ill.
Northwest Engineering Co., 28 E. Jackson, Chicago, Ill.
Thew Shovel Co., Lorain, Ohio.

SILENCERS—Exhaust:
Aluminum Industries, Inc., Cincinnati, Ohio.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Burgess Battery Co., Acoustic Div., 2823-J W. Roscoe St., Chicago, Ill.
Engineering Specialties Co., 39 Cortlandt St., New York City.
Fluor Corp., Ltd., Box 7030, Los Angeles, Calif.
Foster Wheeler Corp., 6 Church St., New York City
McNamar Boiler & Tank Co., Tulsa, Okla.
Maxim Silencer Co., Hartford, Conn.
Weber Engine Works, Kansas City, Mo.

SILICA:
Illinois Minerals Co., Cairo, Ill.
International Filter Co., 325 West 25th Place, Chicago, Ill.
Sullivan Co., The, Memphis, Tenn.

SINKS—Acidproof:
Blickman, S., Inc., Weehawken, N. J.
Duriron Co., The, Inc., Dayton, Ohio.
General Porcelain Enameling & Mfg. Co., 2750 N. Karlov, Chicago, Ill.
Haveg Corp., 919 N. Michigan, Chicago, Ill.
Knight, Maurice A., Akron, Ohio.
U. S. Stoneware Co., The, 60 E. 42nd St., New York City

SLEEVES—Welding, Pipe—See FITTINGS, Welding

SMOKE STACKS—Steel—See STACKS, Steel

SODA ASH:
Diamond Alkali Co., Kippers Bldg., Pittsburgh, Pa.
Du Pont de Nemours, E. I., & Co., Inc., Wilmington, Del.
Mathieson Alkali Works, Inc., 60 E. 42nd St., New York City.
Michigan Alkali Co., 1117 Ford Bldg., Detroit, Mich.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Solvay Sales Corp., 40 Rector St., New York City

SOFTENERS — Water — See CHEMICALS, Water-Treating; also WATER-SOFTENING UNITS

SOLENOIDS:
American Automatic Electric Sales Co., 1033 W. Van Buren, Chicago, Ill.
Automatic Switch Co., 41 E. 11th St., New York City.
Cutler-Hammer, Inc., Milwaukee, Wis.
Detroit Lubricator, 5900 Trumbull Ave., Detroit, Mich.
General Controls Co., Glendale, Calif.
General Electric Co., Schenectady, N. Y.
Guardian Electric Co., 1623 W. Walnut St., Chicago, Ill.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Roebling's, John A., Sons Co., Trenton, N. J.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

SOLVENT-EXTRACTION EQUIPMENT—See PROCESSES, Refinery

SOLVENTS:
Carbide & Carbon Chemicals Corp., 30 East 42nd St., New York City.
Dow Chemical Co., The, Midland, Mich.
Du Pont de Nemours, E. I., & Co., Inc., Wilmington, Del.
Humble Oil & Refining Co., Houston, Tex.
Monsanto Chemical Co., St. Louis, Mo.
Quaker Oats Co., 141 W. Jackson Blvd., Chicago, Ill.
Reilly Tar & Chemical Co., Indianapolis, Ind.
Westvaco Chlorine Products Corp., 135 E. 42nd St., New York City.

SPARK ARRESTORS — Engine-Exhaust — See ARRESTORS, Spark, Engine-Exhaust

SPECIALTY EQUIPMENT—See Separate Items
Enardo Foundry & Mfg. Co., Tulsa, Okla.

SPEED REDUCERS:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Falk Corp., Milwaukee, Wis.
Farrel-Birmingham Co., Inc., Buffalo, N. Y.
Ideal Commutator Dresser Co., Sycamore, Ill.
James, D. O., Mfg. Co., 1114 W. Monroe, Chicago, Ill.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Co., 307 N. Michigan Ave., Chicago, Ill.
Marley Co., The, Kansas City, Kans.
Medart Co., 3512 De Kalb St., St. Louis, Mo.
Oil Well Supply Co., Dallas, Tex.
Worthington Pump & Machinery Corp., Harrison, N. J.

SPRAY NOZZLES—See NOZZLES, Spray:

SPRAY PONDS:
Binks Manufacturing Co., 3124 Carroll Ave., Chicago, Ill.
Fluor Corp., Ltd., Box 7030, Los Angeles, Calif.
Hudson Engineering Co., Houston, Tex.
Marley Co., The, Kansas City, Kans.
Schubert-Christy Corp., Affton Station, St. Louis, Mo.
Spray Engineering Co., Somerville, Mass.
Westinghouse Air Brake Co., Wilmerding, Pa.
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

STABILIZERS:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Badger, E. B., & Sons Co., Boston, Mass.
Beaird Corp., J. B., Shreveport, La.
Braun, C. F., & Co., Inc., Alhambra, Calif.
Hudson Engineering Co., Houston, Tex.
National Tank Co., Tulsa, Okla.
Struthers-Wells Co. (Div. of Struthers Wells-Titusville Corp.), Warren, Pa.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vulcan Steel Tank Corp., Tulsa, Okla.
Wyatt Metal & Boiler Works, Houston, Tex.

STACKS—Steel:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Beaird Corp., J. B., Shreveport, La.
Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio.
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Graver Tank & Mfg. Co., 4809 Todd, East Chicago, Ind.
Green Fuel Economizer Co., Inc., Beacon, N. Y.
Hendrick Mfg. Co., Carbondale, Pa.
Lancaster Iron Works, Lancaster, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.
M & V Tank Co., Wichita Falls, Tex.
Morrison Brothers, Dubuque, Iowa.
Mosher Steel Co., Houston, Tex.
Muskegon Boiler Works, Muskegon, Mich.
Oxley Engineering Co., Ltd., London, England
Patterson Steel Co., Tulsa, Okla.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Union Iron Works, Erie, Pa.
Vulcan Steel Tank Corp., Tulsa, Okla.
Watkins, Inc., Wichita, Kans.
Wickes Boiler Co., Saginaw, Mich.
Wyatt Metal & Boiler Works, Houston, Tex.

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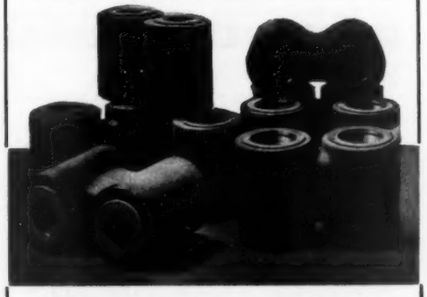

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Hadfields, Ltd., London, England
Lamson & Sessions Co., 1971 W. 85th St., Cleveland, Ohio
Oliver Iron & Steel Corp., 1001 Muriel St., Pittsburgh, Pa.
St. Louis Screw & Bolt Co., St. Louis, Mo.
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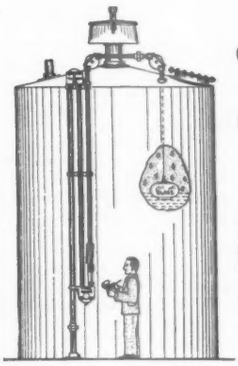
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Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
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Butler Mfg. Co., Kansas City, Mo.
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Maloney Tank Mfg. Co., Tulsa, Okla.
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Blickman, S., Inc., Weehawken, N. J.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
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Haveg Corp., Newark, Del.
Kellogg Co., M. W., 225 Broadway, New York City
Knight, Maurice A., Akron, Ohio
Lancaster Iron Works, Lancaster, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.
Muskegon Boiler Works, Muskegon, Mich.
National Carbon Co., Inc., Cleveland, Ohio
National Tank Co., Tulsa, Okla.
Oxley Engineering Co., Ltd., London, England
Pfaudler Co., The, Rochester, N. Y.
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TANKS—Scrubber—See SCRUBBERS, Gas

TANKS—Septic—See SEPTIC TANKS

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Graver Tank & Mfg. Co., 4809 Todd, East Chicago, Ind.
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McNamar Boiler & Tank Mfg. Co., Tulsa, Okla.
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Petroleum Iron Works Co. of Texas, Beaumont, Tex.
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Lancaster Iron Works, Lancaster, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.
M & V Tank Co., Wichita Falls, Tex.
Mosher Steel Co., Houston, Tex.
Muskegon Boiler Works, Muskegon, Mich.
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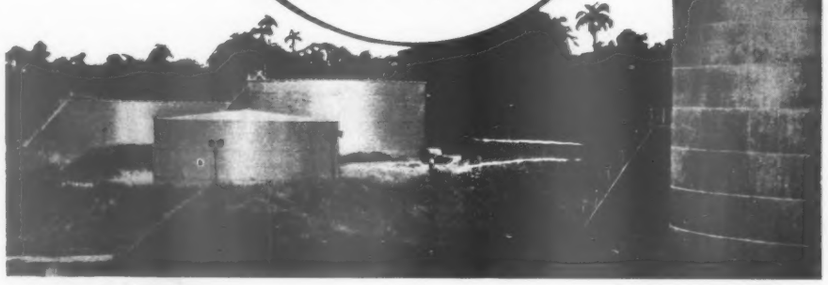

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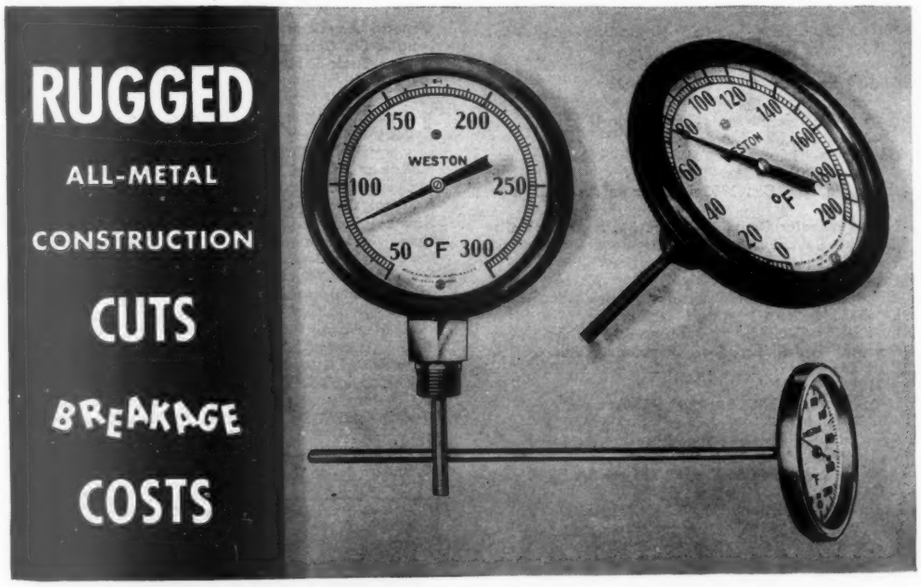

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THIEF HATCHES — See TANK GAUGE and THIEF HATCHES

THIEFS—Oil:
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Greiner, Emil, Co., 55 Van Dam St., New York City
Precision Scientific Co., 1750 N. Springfield Ave., Chicago, Ill.
Refinery Supply Co., Tulsa, Okla.
Shand & Jurs Co., Berkeley, Calif.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Tokheim Co., Cedar Rapids, Iowa
Walker, W. L., Co., Tulsa, Okla.

THREADERS and CUTTERS—Hand-Operated:
Armstrong Bros. Tool Co., 317 N. Francisco, Chicago, Ill.
Beaver Pipe Tools, Inc., Warren, Ohio
Erie Tool Works, The, Erie, Pa.
Greenfield Tap & Die Corp., Greenfield, Mass.
Toledo Pipe Threading Machine Co., Toledo, Ohio
Trimont Mfg. Co., Roxbury, Boston, Mass.

THREADING and CUTTING MACHINES—Pipe and Bolt:
Armstrong Bros. Tool Co., 317 N. Francisco, Chicago, Ill.
Beaver Pipe Tools, Inc., Warren Ohio
Bignall & Keeler Machine Works, Edwardsville, Ill.
Dearborn Chemical Co., 310 S. Michigan, Chicago, Ill.
Jarecki Mfg. Co., St. Louis, Mo.
Landis Machine Co., Waynesboro, Pa.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Toledo Pipe Threading Machine Co., Toledo, Ohio

TILE—Baffle:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Engineer Co., 75 West St., New York City
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Kellogg Co., M. W., 225 Broadway, New York City
LaClede Christy Clay Products Co., St. Louis, Mo.
McLeod & Henry Co., Troy, N. Y.
Mexico Refractories Co., Mexico, Mo.

TILE—Cork:
Armstrong Cork Products Co., Lancaster, Pa.

TILE—Refractory:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bolfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
Carborundum Co., Niagara Falls, N. Y.
Engineer Co., 75 West St., New York City
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Kellogg Co., M. W., 225 Broadway, New York City
LaClede Christy Clay Products Co., St. Louis, Mo.
Norton Co., Worcester, Mass.
Stein, John G., & Co., Ltd., Bonnybridge, Scotland
U. S. Stoneware Co., The, 60 E. 42nd St., New York City

TOOL HOUSES—See HOUSES, Tool

TOOLS—Hand—See Specific Tools

TOOLS—Nonsparking, Safety:
Ampco Metals, Inc., Milwaukee, Wis.
Beryllium Corp. of Pa., Reading, Pa.
Davis Emergency Equipment Co., Inc., Newark, N. J.
Industrial Products Co., 2828 N. 4th St., Philadelphia, Pa.

TOOLS—Pneumatic—See Specific Tools

TOWER PACKING (Rings, Blocks, Etc.):
Carborundum Co., Niagara Falls, N. Y.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Corning Glass Works, Corning, N. Y.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Foster Wheeler Corp., 6 Church St., New York City
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Haveg Corp., Newark, Del.
Kellogg Co., M. W., 225 Broadway, New York City
Knight, Maurice A., Akron, Ohio
Metallo Gasket Co., New Brunswick, N. J.
National Carbon Co., Inc., Cleveland, Ohio
U. S. Stoneware Co., The, 60 E. 42nd St., New York City

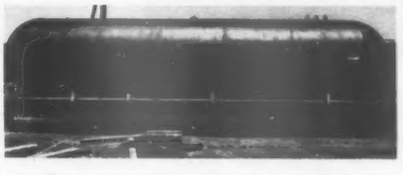
TOWERS—Bubble:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Badger, E. B., & Sons Co., Boston, Mass.
Beaird Corp., J. B., Shreveport, La.
Biggs Boiler Works, The, Akron, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Blaw-Knox Co., Blawnox, Pa.
Braun, C. F., & Co., Inc., Alhambra, Calif.
Devine, J. P., Manufacturing Co., Mount Vernon, Ill.
Edge Moore Iron Works, Inc., 30 Rockefeller Plaza, New York City
Foster Wheeler Corp., 6 Church St., New York City
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Graver Tank & Mfg. Co., 4809 Todd, East Chicago Ind.
Haveg Corp., Newark, Del.
Hudson Engineering Co., Houston, Tex.
Kellogg Co., M. W., 225 Broadway, New York City
Lancaster Iron Works, Lancaster, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.
Muskegon Boiler Works, Muskegon, Mich.
National Tank Co., Tulsa, Okla.
Oxley Engineering Co., Ltd., London, England
Smith, A. O., Corp., Milwaukee, Wis.
Stearns-Roger Mfg. Co., Denver, Colo.
Struthers-Wells Co., Div. of Struthers Wells-Titusville Corp., Warren, Pa.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vogt, Henry, Machine Co., Louisville, Ky.
Vulcan Steel Tank Corp., Tulsa, Okla.
Wheland Co., Chattanooga, Tenn.
Wyatt Metal & Boiler Works, Houston, Tex.

TOWERS—Cooling—See COOLING TOWERS

TOWERS—Evaporator:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Badger, E. B., & Sons Co., Boston, Mass.
Beaird Corp., J. B., Shreveport, La.
Biggs Boiler Works, The, Akron, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
Devine, J. P., Manufacturing Co., Mount Vernon, Ill.
Foster Wheeler Corp., 6 Church St., New York City
Gasoline Plant Construction Co., Houston, Tex.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Haveg Corp., Newark, Del.
Hudson Engineering Co., Houston, Tex.
Kellogg Co., M. W., 225 Broadway, New York City
Lancaster Iron Works, Lancaster, Pa.
Muskegon Boiler Works, Muskegon, Mich.
National Tank Co., Tulsa, Okla.
Oxley Engineering Co., Ltd., London, England
Stearns-Roger Mfg. Co., Denver, Colo.
Sun Shipbuilding & Drydock Co., Chester, Pa.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vulcan Steel Tank Corp., Tulsa, Okla.
Wyatt Metal & Boiler Works, Houston, Tex.

TOWERS—Fractionating:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
Badger, E. B., & Sons Co., Boston, Mass.
Beaird Corp., J. B., Shreveport, La.
Biggs Boiler Works, The, Akron, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Blaw-Knox Co., Blawnox, Pa.
Braun, C. F., & Co., Inc., Alhambra, Calif.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
Devine, J. P., Manufacturing Co., Mount Vernon, Ill.
Edge Moore Iron Works, Inc., 30 Rockefeller Plaza, New York City
Foster Wheeler Corp., 6 Church St., New York City
Gasoline Plant Construction Co., Houston, Tex.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Graver Tank & Mfg. Co., 4809 Todd, East Chicago, Ind.
Haveg Corp., Newark, Del.
Hudson Engineering Co., Houston, Tex.
Kellogg Co., M. W., 225 Broadway, New York City
Lancaster Iron Works, Lancaster, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.
Muskegon Boiler Works, Muskegon, Mich.
National Carbon Co., Inc., Cleveland, Ohio
National Tank Co., Tulsa, Okla.
Oxley Engineering Co., Ltd., London, England
Smith, A. O., Corp., Milwaukee, Wis.
Stearns-Roger Mfg. Co., Denver, Colo.
Stratford Engineering Corp., Kansas City, Mo.
Struthers-Wells Co., Div. of Struthers Wells-Titusville Corp., Warren, Pa.
Sun Shipbuilding & Drydock Co., Chester, Pa.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vulcan Steel Tank Corp., Tulsa, Okla.
Watkins, Inc., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.

TRANSPORTATION—Liquefied Petroleum:
McNamar Boiler & Tank Co., Tulsa, Okla.



Pressure storage vessels for natural gasoline, Butane, Iso Butane mixtures and Propane. API-ASME or ASME U-69 construction.

McNAMAR
BOILER & TANK CO.
Tulsa, Okla. Salem, Ill.

TRANSFORMERS—Distribution:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Moloney Electric Co., St. Louis, Mo.
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TRANSFORMERS—Power:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Moloney Electric Co., St. Louis, Mo.
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TRAPS—Air:

Anderson, V. D., Co., Cleveland, Ohio
Armstrong Machine Works, Three Rivers, Mich.
Fisher Governor Co., Marshalltown, Iowa
Hanlon-Waters, Inc., Tulsa, Okla.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kaye & MacDonald, Inc., West Orange, N. J.
Kieley & Mueller, Inc., 40 W. 13th St., New York City
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
McNamar Boiler & Tank Co., Tulsa, Okla.
Nicholson, W. H., & Co., Wilkes-Barre, Pa.
Sarco Co., Inc., 475 5th Ave., New York City
Squires, C. E., Co., 3934 Kelly Ave., Cleveland, Ohio
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

TRAPS—Ball Float:

Anderson, V. D., Co., Cleveland, Ohio
Armstrong Machine Works, Three Rivers, Mich.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Hanlon-Waters, Inc., Tulsa, Okla.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kaye & McDonald, Inc., West Orange, N. J.
Kieley & Mueller, Inc., 40 W. 13th St., New York City
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Newman, Hender & Co., Ltd., Woodchester, England
Nicholson, W. H., & Co., Wilkes-Barre, Pa.
Sarco Co., Inc., 475 5th Ave., New York City
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

TRAPS—Blast:

Anderson, V. D., Co., Cleveland, Ohio
Armstrong Machine Works, Three Rivers, Mich.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kaye & McDonald, Inc., West Orange, N. J.
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Nicholson, W. H., & Co., Wilkes-Barre, Pa.
Sarco Co., Inc., 475 5th Ave., New York City
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

TRAPS—Bucket:

Anderson, V. D., Co., Cleveland, Ohio
Armstrong Machine Works, Three Rivers, Mich.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Crane Co., Michigan Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kaye & McDonald, Inc., West Orange, N. J.
Kieley & Mueller, Inc., 40 W. 13th St., New York City
Newman, Hender & Co., Ltd., Woodchester, England
Sarco Co., Inc., 475 5th Ave., New York City
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio
Vapor Recovery Systems Co., Compton, Calif.
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

TRAPS—Forged Steel:

Anderson, V. D., Co., Cleveland, Ohio
Armstrong Machine Works, Three Rivers, Mich.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Nicholson, W. H., & Co., Wilkes-Barre, Pa
Sarco Co., Inc., 475 5th Ave., New York City
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

TRAPS—Gasoline:

Anderson, V. D., Co., Cleveland, Ohio
Armstrong Machine Works, Three Rivers, Mich.
Fisher Governor Co., Marshalltown, Iowa
Hanlon-Waters, Inc., Tulsa, Okla.
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
McNamar Boiler & Tank Co., Tulsa, Okla.
Nicholson, W. H., & Co., Wilkes Barre, Pa.
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

TRAPS—Piston-Operated:

Armstrong Machine Works, Three Rivers, Mich.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Nicholson, W. H., & Co., Wilkes Barre, Pa.
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio

TRAPS—Steam:

American District Steam Co., N. Tonawanda, N. Y.
Anderson, V. D., Co., Cleveland, Ohio
Armstrong Machine Works, Three Rivers, Mich.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Coe Mfg. Co., The, Painesville, Ohio
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Hanlon-Waters, Inc., Tulsa, Okla.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
International Filter Co., 325 W. 25th Place, Chicago, Ill.
Kaye & McDonald, Inc., West Orange, N. J.
Kieley & Mueller, Inc., 40 W. 13th St., New York City
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Newman, Hender & Co., Ltd., Woodchester, England
Nicholson, W. H., & Co., Wilkes Barre, Pa.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Reading, Pa.
Sarco Co., Inc., 475 5th Ave., New York City
Squires, C. E., Co., 3934 Kelly Ave., Cleveland, Ohio
Stewarts & Lloyds, Ltd., Glasgow, Scotland
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

TRAPS—Vacuum:

Anderson, V. D., Co., Cleveland, Ohio
Fisher Governor Co., Marshalltown, Iowa
Hanlon-Waters, Inc., Tulsa, Okla.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

TRAYS—Bubble:

American Locomotive Co., Alco Products Div., 30 Church St., New York City
Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
Badger, E. B., & Sons Co., Boston, Mass.
Beaird Corp., J. B., Shreveport, La.
Biggs Boiler Works, The, Akron, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Blickman, S., Inc., Weehawken, N. J.
Braun, C. F., & Co., Inc., Alhambra, Calif.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Devine, J. P., Manufacturing Co., Mount Vernon, Ill.
Fluor Corp., Ltd., Box 7030, Los Angeles, Calif.
Hadfields, Ltd., London, England
Hudson Engineering Co., Houston, Tex.
Kellogg Co., M. W., 225 Broadway, New York City
Lancaster Iron Works, Lancaster, Pa.
Mosher Steel Co., Houston, Tex.
Ohio Steel Foundry Co., The, Springfield, Ohio
Stearns-Roger Mfg. Co., Denver, Colo.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vulcan Steel Tank Corp., Tulsa, Okla.
Watkins, Inc., Wichita, Kans.
Weber Engine Works, Kansas City, Mo.
Wheland Co., Chattanooga, Tenn.
Winkler-Koch Engineering Co., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.

TREADS—Stair—See STAIR TREADS, Steel

TREATERS—Emulsion:

Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Burt Tank, Separator & Oil Treating Corp., Wichita Falls, Tex.
National Tank Co., Tulsa, Okla.

TREATERS—Continuous:

Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Burt Tank, Separator & Oil Treating Corp., Wichita Falls, Tex.
Fulton Sylphon Co., The, Knoxville, Tenn.
McNamar Boiler & Tank Co., Tulsa, Okla.
Turbo-Mixer Corp., The, 247 Park Ave., New York City
Winkler-Koch Engineering Co., Wichita, Kans.

TRUCKS—Motor:

Auto Car Co., Ardmore, Pa.
Chevrolet Motor Co., Detroit, Mich.
Coleman Motors Corp., Littletown, Colo.
Diamond T Motor Car Co., 4501 W. 26th St., Chicago, Ill.
Dodge Div., Chrysler Corp., Detroit, Mich.
Federal Motor Truck Co., 5780 Federal, Detroit, Mich.
Ford Motor Co., Dearborn, Mich.
Four Wheel Drive Auto Co., Clintonville, Wis.
General Motors Truck Co., Pontiac, Mich.
Hug Company, The, Highland, Ill.
International Harvester Co., 180 N. Michigan Ave., Chicago, Ill.
Mack Trucks, Inc., Long Island City, N. Y.
Marmon-Herrington Co., Indianapolis, Ind.
Reo Motor Car Co., Lansing, Mich.
Studebaker Corp., South Bend, Ind.
White Co., The, 842 E. 79th St., Cleveland, Ohio

TREATING PLANTS—See PLANTS

TUBE CLEANERS—See CLEANERS, Tube

TUBE EXPANDERS—See EXPANDERS, Tube

TUBE HANGERS—See SUPPORTS, Tube

TUBE SUPPORTS—See SUPPORTS, Tube

TUBES—Alloy-Steel:

Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Duraloy Co., The, Scottdale, Pa.
Globe Steel Tubes Co., Milwaukee, Wis.
Kellogg Co., M. W., 225 Broadway, New York City
National Tube Co., Box 266, Pittsburgh, Pa.
Ohio Seamless Tube Co., The, Shelby, Ohio
Ohio Steel Foundry Co., The, Springfield, Ohio
Pittsburgh Piping & Equipment Co., 10-43rd St., Pittsburgh, Pa.
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, Ohio
Revere Copper & Brass, Inc., 230 Park Ave., New York City
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Steel & Tubes, Inc., 224 E. 131st St., Cleveland, Ohio
Texas Pipe Bending Co., Houston, Tex.
Timken Roller Bearing Co. (Steel and Tube Div.), Canton, Ohio
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

TUBES—Boiler:

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Globe Steel Tubes Co., Milwaukee, Wis.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
National Tube Co., Box 266, Pittsburgh, Pa.
Ohio Seamless Tube Co., The, Shelby, Ohio
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago Ill.
Steel & Tubes, Inc., 224 E. 131st St., Cleveland, Ohio
Stewarts & Lloyds, Ltd., Glasgow, Scotland
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

TUBES—Brass and Copper:

American Brass Co., 25 Broadway, New York City
Bridgeport Brass Co., Bridgeport, Conn.
Chase Brass & Copper Co., Waterbury, Conn.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Foster Wheeler Corp., 6 Church St., New York City
Gilbert Brass Foundry Co., St. Louis, Mo.
Revere Copper & Brass, Inc., 230 Park Ave., New York City
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.

Scovill Mfg. Co., Waterbury, Conn.
Wolverine Tube Co., 1411 Central Ave., Detroit, Mich.

TUBES—Condenser:
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
American Brass Co., 25 Broadway, New York City
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bridgeport Brass Co., Bridgeport, Conn.
Byers, A. M., Co., Box 83, Pittsburgh, Pa.
Cast Iron Pipe Research Ass'n., 122 S. Michigan, Chicago, Ill.
Chase Brass & Copper Co., Waterbury, Conn.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Duriron Co., The, Inc., Dayton, Ohio
Engineers & Fabricators, Inc., Houston, Tex.
Foster Wheeler Corp., 6 Church St., New York City
Globe Steel Tubes Co., Milwaukee, Wis.
Kellogg Co., M. W., 225 Broadway, New York City
McWane Cast Iron Pipe Co., Birmingham, Ala.
National Tube Co., Box 266, Pittsburgh, Pa.
Ohio Seamless Tube Co., The, Shelby, Ohio
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York City
Scovill Mfg. Co., Waterbury, Conn.
Steel & Tubes, Inc., 224 E. 131st St., Cleveland, Ohio
Timken Roller Bearing Co. (Steel and Tube Div.), Canton, Ohio
Wolverine Tube Co., 1411 Central Ave., Detroit, Mich.

TUBES—Corrosion-Resisting:
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
American Brass Co., 25 Broadway, New York City
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Burgess-Parr Co., Freeport, Ill.
Calorizing Co., The, Wilkinsburg Station, Pittsburgh, Pa.
Duraloy Co., The, Scottdale, Pa.
Globe Steel Tubes Co., Milwaukee, Wis.
Haveg Corp., 919 N. Michigan, Chicago, Ill.
Haynes Stellite Co., Kokomo, Ind.
Kellogg Co., M. W., 225 Broadway, New York City
National Carbon Co., Inc., Cleveland, Ohio
National Tube Co., Box 266, Pittsburgh, Pa.
Ohio Steel Foundry Co., The, Springfield, Ohio
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York City
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Steel & Tubes, Inc., 224 E. 131st St., Cleveland, Ohio
Timken Roller Bearing Co. (Steel and Tube Div.), Canton, Ohio
Wolverine Tube Co., 1411 Central Ave., Detroit, Mich.
Youngstown Sheet & Tube Co., The, Youngstown, Ohio.

TUBES—Cracking-Still:
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Calorizing Co., The, Wilkinsburg Station, Pittsburgh, Pa.
Globe Steel Tubes Co., Milwaukee, Wis.
Kellogg Co., M. W., 225 Broadway, New York City
National Tube Co., Box 266, Pittsburgh, Pa.
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Timken Roller Bearing Co. (Steel and Tube Div.), Canton, Ohio

TUBES—Finned:
Foster Wheeler Corp., 6 Church St., New York City
Globe Steel Tubes Co., Milwaukee, Wis.
Griscom-Russell Co., The, 285 Madison Ave., New York City
Wolverine Tube Co., 1411 Central Ave., Detroit, Mich.

TUBES—Pyrometer:
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Carborundum Co., Niagara Falls, N. Y.
Englehard, Charles, Inc., Newark, N. J.
Globe Steel Tubes Co., Milwaukee, Wis.
Greiner, Emil, Co., 55 Van Dam St., New York City
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
National Carbon Co., Inc., Cleveland, Ohio
Norton Co., Worcester, Mass.
Ohio Steel Foundry Co., The, Springfield, Ohio

TUBES—Seamless Steel:
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Engineers & Fabricators, Inc., Houston, Tex.
Globe Steel Tubes Co., Milwaukee, Wis.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
National Tube Co., Box 266, Pittsburgh, Pa.
Ohio Seamless Tube Co., Shelby, Ohio
Pittsburgh Piping & Equipment Co., 10-43rd St., Pittsburgh, Pa.
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago.
Steel & Tubes, Inc., 224 E. 131st St., Cleveland, Ohio
Stewarts & Lloyds, Ltd., Glasgow, Scotland
Texas Pipe Bending Co., Houston, Tex.
Timken Roller Bearing Co. (Steel and Tube Div.), Canton, Ohio
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

TUBING—Centrifugally Cast:
Ampco Metals, Inc., Milwaukee, Wis.
Bethlehem Steel Co., Bethlehem, Pa.
Burgess-Parr Co., Freeport, Ill.
Clow, James B., & Sons, 201 N. Talman, Chicago, Ill.
Duraloy Co., The, Scottdale, Pa.
Ohio Steel Foundry Co., The, Springfield, Ohio
Shenango-Penn Mold Co., Dover, Ohio
U. S. Pipe & Foundry Co., Burlington, N. J.

TUBING—Copper:
American Brass Co., 25 Broadway, New York City
Bridgeport Brass Co., Bridgeport, Conn.
Chase Brass & Copper Co., Waterbury, Conn.
Foster Wheeler Corp., 6 Church St., New York City
Gilbert Brass Foundry Co., St. Louis, Mo.
Mueller Co., Decatur, Ill.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York City
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Scovill Mfg. Co., Waterbury, Conn.
Wolverine Tube Co., 1411 Central Ave., Detroit, Mich.

TUBING—Flexible, Metal:
American Brass Co., 25 Broadway, New York City
Atlantic Metal Hose Co., 123 West 64th St., New York City
Chicago Metal Hose Corp., Maywood, Ill.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Seamless Co., Inc., 5-19 48th Ave., Long Island City, N. Y.

TUBING—High-Pressure, Flexible Metal:
American Brass Co., 25 Broadway, New York City
Chicago Metal Hose Corp., Maywood, Ill.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.

TUBING—Mechanical:
Allegheny Ludlum Steel Corp., Pittsburgh,, Pa.
American Brass Co., 25 Broadway, New York City
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Clayton Mark & Co., Evanston, Ill.
Globe Steel Tubes Co., Milwaukee, Wis.
National Tube Co., Box 266, Pittsburgh, Pa.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 West 16th St., Chicago, Ill.
Steel & Tubes, Inc., 224 East 131st St., Cleveland, Ohio
Stewarts & Lloyds, Ltd., Glasgow, Scotland
Timken Roller Bearing Co. (Steel and Tube Div.), Canton, Ohio

TUBING—Seamless, Flexible Metal:
American Brass Co., 25 Broadway, New York City
Atlantic Metal Hose Co., 123 West 64th St., New York City
Chicago Metal Hose Corp., Maywood, Ill.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Seamless Co., Inc., 5-19 48th Ave., Long Island City, N. Y.

TUBING—Steel:
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Globe Steel Tubes Co., Milwaukee, Wis.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
National Tube Co., Box 266, Pittsburgh, Pa.
Pittsburgh Piping & Equipment Co., 10-43rd St., Pittsburgh, Pa.
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 West 16th St., Chicago, Ill.
South Chester Tube Co., Chester, Pa.
Steel & Tubes, Inc., 224 East 131st St., Cleveland, Ohio
Stewarts & Lloyds, Ltd., Glasgow, Scotland
Texas Pipe Bending Co., Houston, Tex.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

TUBING—Steel, Seamless:
Allegheny Ludlum Steel Corp., 2319 Oliver Bldg., Pittsburgh, Pa.
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Globe Steel Tubes Co., Milwaukee, Wis.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
National Tube Co., Box 266, Pittsburgh, Pa.
Ohio Seamless Tube Co., The, Shelby, Ohio
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 West 16th St., Chicago, Ill.
South Chester Tube Co., Chester, Pa.
Spang Chalfant Div. (The National Supply Co.), Pittsburga, Pa.
Stewarts & Lloyds, Ltd., Glasgow, Scotland
Texas Pipe Bending Co., Houston, Tex.
Timken Roller Bearing Co. (Steel and Tube Div.), Canton, Ohio
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

TURBINES — Deep-Well — See PUMPS, Turbine, Deep-Well

TURBINES—Gas:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Coppus Engineering Corp., Worcester, Mass.
Elliott Co., Springfield, Ohio
General Electric Co., Schenectady, N. Y.
Terry Steam Turbine Co., The, Hartford, Conn.

TURBINES—Steam:
Allen, W. H., Sons & Co., Ltd., Bedford, England
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Carling Turbine Blower Co., Worcester, Mass.
Coppus Engineering Co., 344 Park Ave., New York City
Dean Hill Pump Co., Anderson, Ind.
DeLaval Steam Turbine Co., Trenton, N. J.
Elliott Co., Springfield, Ohio
General Electric Co., Schenectady, N. Y.
Moon Manufacturing Co., 122 North Jefferson, Chicago, Ill.
Pyle National Co., 1334 North Kostner, Chicago, Ill.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Terry Steam Turbine Co., Hartford, Conn.
Worthington Pump & Machinery Corp., Harrison, N. J.

TURNBUCKLES:
Bethlehem Steel Co., Bethlehem, Pa.
Glover Bros., Ltd., London, England
Laughlin, Thomas, Co., Portland, Me.
Mosher Steel Co., Houston, Tex.
Oil Well Supply Co., Dallas, Tex.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Sheffield Steel Corp., Kansas City, Mo.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.

TURBO—Generators—See GENERATOR UNITS, Turbine-Driven

UNIONS—Ball Joint:
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Fairbanks Co., The, 393 Lafayette St., New York City
Flagg, Stanley G., & Co., 1421 Chestnut St., Philadelphia, Pa.
Jarecki Mfg. Co., St. Louis, Mo.
Morrison Brothers, Dubuque, Iowa
Rhode Island Fittings Co., Hillsgrove, R. I.
Walworth Co., 60 East 42nd St., New York City

UNIONS—Drop Forged Steel:
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Jarecki Mfg. Co., St. Louis, Mo.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
M & H Valve & Fittings Co., Anniston, Ala.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Rhode Island Fittings Co., Hillsgrove, R. I.
Walworth Co., 60 East 42nd St., New York City
Westinghouse Air Brake Co., Wilmerding, Pa.

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Jarecki Mfg. Co., St. Louis, Mo.
Jefferson Union Co., New York City
Kennedy Valve Mfg. Co., Elmira, N. Y.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Rhode Island Fittings Co., Hillsgrove, R. I.
Walworth Co., 60 East 42nd St., New York City

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Frick Co., Waynesboro, Pa.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Jarecki Mfg. Co., St. Louis, Mo.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
Walworth Co., 60 East 42nd St., New York City

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Hadfields, Ltd., London, England
Mark, Clayton, & Co., Evanston, Ill.

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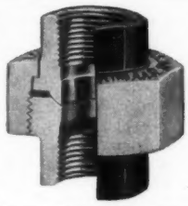

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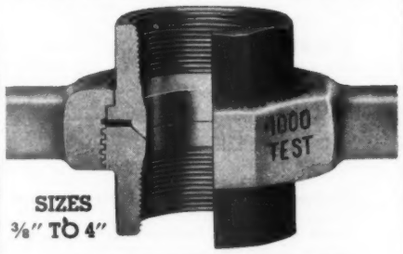

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Jarecki Mfg. Co., St. Louis, Mo.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Rhode Island Fittings Co., Hillsgrove, R. I.
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Victaulic Co. of America, 30 Rockefeller Plaza, New York City
Walworth Co., 60 East 42nd St., New York City

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Detroit Brass & Malleable Works, 100 So. Campbell Ave., Detroit, Mich.
Flagg, Stanley G., & Co., 1421 Chestnut St., Philadelphia, Pa.
Jarecki Mfg. Co., St. Louis, Mo.
Jefferson Union Co., 601 W. 26th St., New York City
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VACUUM PUMPS—See PUMPS, Vacuum

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Hills-McCanna, 2349 Nelson, Chicago, Ill.
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Lunkenheimer Co., The, Cincinnati, Ohio
Merco Nordstrom Valve Co., Homewood, Pittsburgh, Pa.
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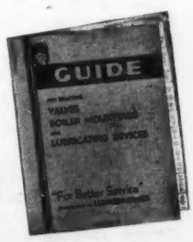

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Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
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McDonald, A. Y., Mfg. Co., Dubuque, Iowa
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Milwaukee Valve Co., Milwaukee, Wis.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Newman, Hender & Co., Ltd., Woodchester, England
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Newman, Hender & Co., Ltd., Woodchester, England
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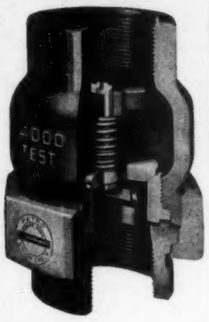

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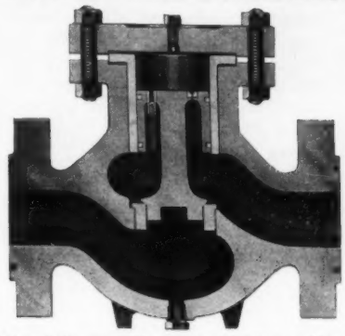

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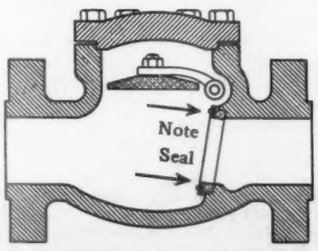

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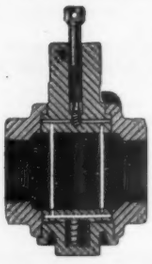

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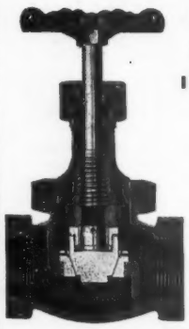

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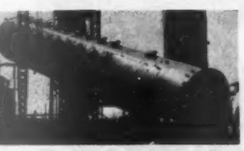
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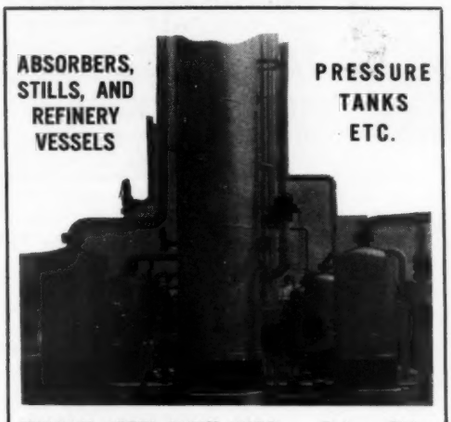

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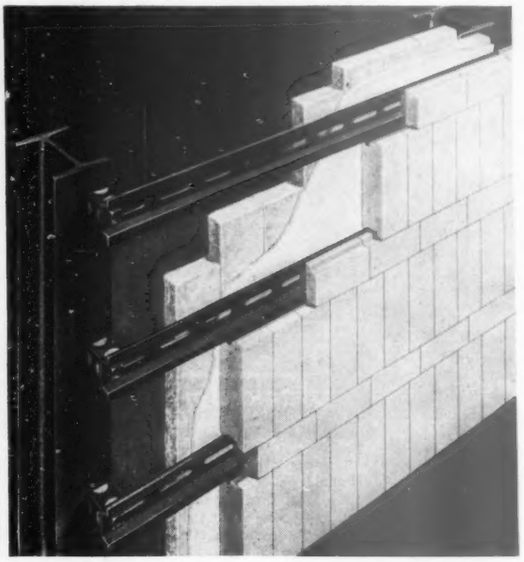

The view at the left shows the Bigelow Budget Wall which is the thin design of the series of Bigelow Unit-Suspended walls. It has all the design features of the heavier and older types of Bigelow walls but is used where lower temperatures combined with slagless operation are encountered.

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WATER HEATERS—See HEATERS, Water:

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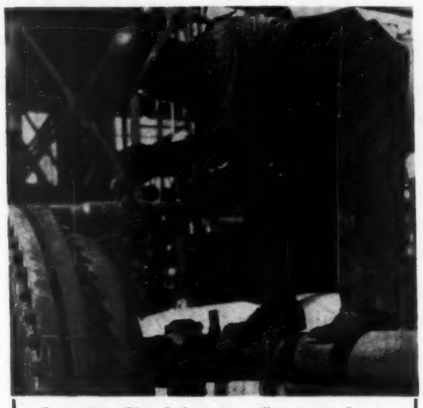

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The Oil and Gas Journal, Tulsa, Oklahoma

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ENGINEERING *and Operating* SECTION

▼

Effective Camouflage As Means Of Protecting Oil Property

By K. J. KEATING
Technical Director, Mid-Continent Division,
General Paint Co.

When air raids come to this country, if they ever do, blackout precautions will hamper the enemy bombers' destructive work at night. Skilful camouflage will be the daylight equivalent of the nighttime blackout. A discussion of the art of camouflage is here presented, together with some definite instructions on how to disguise property so that the bombardier's efforts will be at least partially nullified. It's not done with mirrors, nor with the zigzag, crazy-quilt pattern effect of the last war, but with irregular lines and colors.

AS this is written, German U-boats are raiding in the Caribbean, a West Coast refinery has been shelled, and American tankers are being sunk within sight of our own shores.

The immediate object of these attacks is to harass and delay American industry. But there is a further objective. Undoubtedly, our foes hope that we will be frightened into a dispersion of our naval forces.

If submarine attacks fall short of this second and major objective, it is possible that air raids may be attempted upon our coastal cities and industries. Enemy long-range bombers can fly to the Caribbean, where conceivably they can be refueled and loaded with bombs for an attack upon our Gulf Coast oil fields. The risk would be great, but we know our enemies to be bold and desperate gamblers.

It is not to be expected that we will be confronted with mass flights of dive bombers; these are comparatively short-ranged aircraft and could not reach our shores nor carry sufficient ammunition to be effective.

We may be sure that if the enemy comes, it will be in long-range aircraft, that he will not attempt mass bombing of small areas but will depend upon precision bombing of selected targets. Rather than carry a few large bombs, he will carry as many light bombs as possible. For such a raid, oil-storage tanks and refineries offer exceptionally vulnerable targets. A comparatively light bomb can burst and ignite a storage tank or wreak havoc in a refinery.

Effective camouflage will greatly diminish the bombardier's percentage of hits and minimize the damage caused. The enemy undoubtedly has accurate maps of our oil fields. He may be guided to his targets by easily recognized land marks, but he must see the actual target very plainly in order to hit it effectively.

It must be remembered that the bombardier approaches his target at a high speed, locates it by means of a land mark, if possible, probably circles and then levels out for a "run" of 2 or 3 miles. This run may require as little as 30 seconds, during which brief time the bombardier must make adjustments for speed, height, and distance from the target, pick up the target in his bomb sight and release the bombs at just exactly the right fraction of a second.

If the bombardier is handicapped by camouflage, his percentage of hits will be considerably decreased and the damage greatly minimized. By the use of common sense and the fundamentals of the art, an inexperienced person can effectively camouflage many possible targets. Being an amateur is nothing to be ashamed of; we have done little in the way of camouflage, and any experts we may have are in the Army.

We can readily visualize a white storage tank in the midst of plowed fields or pastures and appreciate what a shining mark it is. By changing the color to resemble that of the surroundings we very greatly reduce the visibility. The difference is so great that we are apt to consider an exact match of the surroundings to be absolutely essential.

Because colors tend to lose their brilliance and fade into more neutral shades when viewed from a distance, it is not absolutely necessary that the colors employed be identical with those of the immediate surroundings, but the color scheme must be one that blends into the landscape as a whole.

The Army has evolved nine standard colors for camouflage use. By selection of suitable colors, it is possible to select combinations which will give the desired result in almost any surrounding.

These colors have names which effectively describe their shade and use. They are as follows:

1. Light green.
2. Dark green.
3. Sand.
4. Field drab.
5. Earth brown.
6. Earth yellow.
7. Loam.
8. Earth red
9. Olive drab.
10. Black.

All paint manufacturers have received color cards of the standard Army shades. Before ordering out any paint, consult the color cards, design a scheme and check it against the actual surroundings.

In designing the color scheme you will note there are three greens: light green, dark green and olive drab. Some combination of these will resemble each and every type of vegetation. Incidentally, it is much better to use all three shades than to stick to any one of them.

There are five colors which represent different types of earth. Include appropriate earth colors in your color scheme to the extent of 10

The author (seated) and Max Thal, chemist, working on experimental camouflage table. This arrangement allows the paint chemist to study the visual and photographic properties of different pigment combinations under both white light and infrared rays used for aerial photography. A plant may be compared with various samples of soil, vegetation and other colors of paint

or 20 per cent for normally vegetated areas, more for scantily vegetated areas.

Field drab represents either soil or dried vegetation, it is a good utility color and will work into almost any scheme.

Do not use black at all unless you have a very definite reason. Black is seldom used in nature. Shadows are not black, they are simply darker colored areas.

The black camouflage paint may be used for "blacking out" windows, but as yet our situation scarcely calls for such a drastic step. Be careful about painting glass black, it may heat in the sun and crack.

Incidentally, these army colors are designed so that they will not photograph too well, which is a distinct advantage. This is very important to the army, as they have many targets which may be both photographed and bombed. The civilian need not bother about aerial photography. He will be menaced, if at all, by a few sneak raids and the enemy, like lightning, will seldom strike the same spot twice.

Form

Any man-made object is characterized by the use of the straight line, the right angle and the sharp corner. Nature will have none of these; she employs no straight lines. Therefore, any straight roof lines, tall chimneys or straight roads are a dead give away.

We must break up the form by using irregular arrangements of different colors. These colors should not contrast too greatly but must be sufficiently different so that the irregular areas they delineate will disguise presence of straight lines.

The zigzag designs and patterns used in the last war to camouflage should be avoided, as they were designed for use upon water. Instead, irregular but simple patterns should be employed.

Design the color scheme boldly. What seem to be large areas from the ground may be too small to give the desired effect when viewed from the air. We must remember that from a great distance the eye merges small areas, thus when viewed from a sufficient height a black and white checkerboard would appear to be gray.

If the creation of such a pattern troubles your imagination, try this expedient. Toss from three to five oak leaves onto a piece of white letter paper. Outline the edges with a pencil, transfer this pattern to the entire surface to be camouflaged. If you don't like it, change it; at least you have made a start.

Of course, you will carry your designs around the corners, that is, do not allow any area of color to stop at a corner or roof line. Avoid the conventional, as the weirdest designs are frequently the most effective.

Natural surfaces are never smooth and mirrorlike. They are, as the painter says, "flat," that is, they will not give a mirrorlike reflection. Glossy, shiny paints will do so and are to be avoided. The camouflage finishes recommended by the Army are perfectly flat, and give no mirrorlike reflection at all. Some thought must be given to the texture of the surroundings. If a tank stands in a smooth pasture, little need be done besides applying the camouflage paint. If it is in rugged or timbered surroundings, some tree limbs placed around the base and on the roof will be helpful.

A tank may be camouflaged to the point of invisibility, but its shadow will show very plainly. Shadows are hard to hide but can be broken up rather effectively in wooded country by the irregular planting of trees and shrubs. Inexpensive, quick growing varieties such as willow and cottonwood are to be recommended. Planting in rows is to be avoided and the bulk of the planting should be due north and south of the tank.

In a perfectly flat, shrubless area, shadows are difficult to hide and it is well to resort to dummy targets, which will have dummy shadows.

Dummy Targets

In the case of tanks, dummy targets are quite easy and inexpensive to make. Remember, they should not be too close to the real target. It is not necessary to imitate a new white tank with steps, walks and handrails. It is probably as effective to make a rather hazy representation of a camouflage tank by tracing a circle on the ground with old timbers, chat or even bottom settlings. As a slight elaboration, a shadow fence may be built of scrap material around the north half of the circle. Shadows may also be faked with bottom settlings or slush-pit material. In no case should the imitation be too obvious, nor does it have to be too good. It is not necessary to fool the enemy all day, but only for a few seconds.

A well complete with derrick and pump scarcely can be disguised, but it is actually a difficult target and the damage is not apt to be great. The enemy will not waste bombs upon wells; he will try for refineries first, storage tanks second. Gasoline plants and pumping stations might draw some attention.

A refinery is a big target and one that is hard to hide. However, the visibility may be greatly lowered by a suitable camouflage painting scheme. Damage may be minimized by extending the boundaries of the refinery proper with fake fences and fake stills built of junk.

Gasoline plants and pumping stations can be disguised by camouflaging some of the buildings and painting the others to resemble a farm complete with the traditional white house and red barn.

Summer and Winter

In general, camouflage to imitate the conditions of a dry summer. The enemy hopes to divert our navy, and if his attempts are fruitless, he will probably not continue such difficult and desperate attacks past the summer months. After the summer of 1942, which will probably be a black one, we will be dishing it out, not taking it.

However, paint is paint, and costs money. It it, therefore, best to select a paint of good durability. Such a finish will protect the equipment against rust for a long time and will provide a suitable base for repainting with standard paints, which is very important.

Flat, lusterless paints are easy to make, and the addition of sufficient silica flour or china clay will make any paint flat. They are difficult to formulate, however, to give good durability and for this reason it is best to buy the product of a reputable manufacturer whose technical staff has a record of experience in the production of such finishes. Do not buy a paint durable only for the duration.

Camouflaged buildings or equipment lose nothing in the way of advertising value. They may be hard to see from the air, but will be plainly noticed from a passing automobile and will be noted and remembered rather than forgotten.

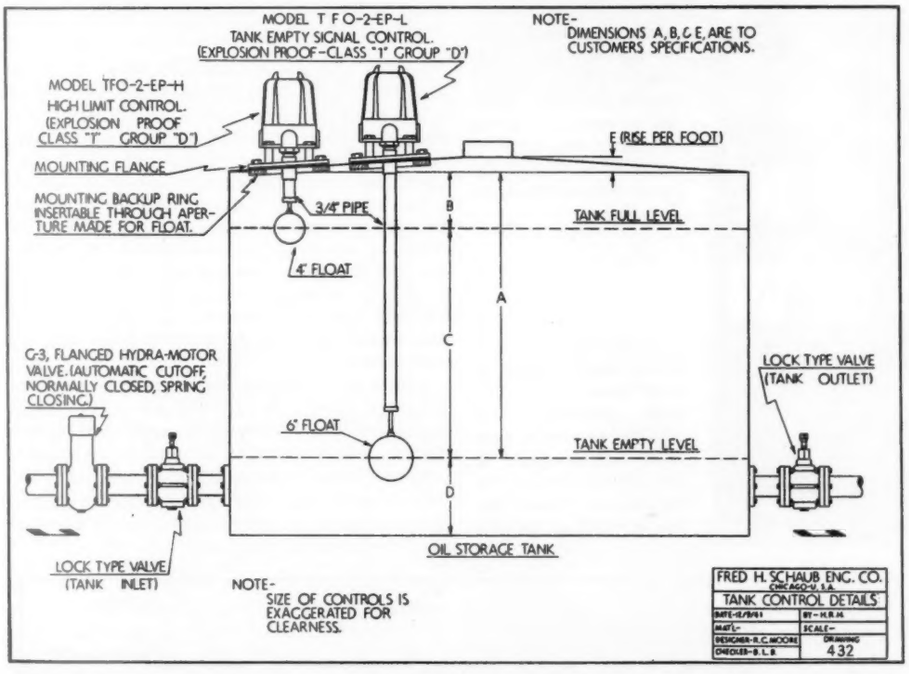
Automatic Tank-Battery Control Simplifies Lease Operation

By HARRY F. SIMONS

Use of a centrally located tank battery for the production from a large group of wells greatly increases the efficiency of the operation. Through the installation of automatic controls, the pumper on a lease in the Burbank, Oklahoma, field is allowed more time for duties away from the tank battery. The installation described in this article includes 10 tanks of 1,000 bbl. capacity each and handles approximately 4,600 bbl. of oil per day.

AUTOMATIC controls have been used widely in the refining and pipe-line branches of the oil industry for a number of years and the producing departments are now beginning to adapt this method to field use. Principal advantages are its economy in over-all operating cost plus furthering of the gravity-conservation programs now being enforced by the oil companies. Use of the automatic control allows the pumper to devote greater care to the equipment without danger of overflowing a tank.

An outstanding example of what can be done with automatic controls can be found in the South Burbank field (Little Chief), Oklahoma, where a battery of ten 1,000-bbl. tanks automatically handles approximately 4,600 bbl. per day. The pumper does not have to open or close any valves except those used in running oil from the tanks.



Equipment on each tank includes high and low-limit switches controlled by the fluid level, an automatic valve interlocked with the limit switches and the necessary stop cocks

Principal advantages of such an automatic system are that it fills the desired tank and automatically switches the production to the next empty tank and so on until all tanks have been filled. The cycle must then be automatically repeated as some of the tanks will have been emptied into the pipe line in the meantime. The system must also provide for the selection of a particular tank to be filled and it must have some reserve space for an emergency when all operating tanks happen to be full.

Through the installation of an electric control system it is possible to fill and empty the tanks on the Phillips-operated lease without any danger of overflowing a tank, or backing oil up into the separator or losing any production. It is totally and completely automatic and so far as is known it is the only system of its kind in existence.

Principal parts of the system are high and low-limit automatic liquid-level control switches, electrically operated hydraulic valves and holding circuit relays, and a master control panel. Installation of the control equipment used on the individual tanks is shown in Fig. 1. The limit-control switches are explosionproof Class 1, Group D type.

Layout of the tank battery is shown in Fig. 2. The oil production from the wells is manifolded to the tanks in the regular manner with the exception of the control equipment as is the outlet for delivery to the pipe lines. The conduit layout is also shown in Fig. 2.

The control panel includes 10 control switch plates, one for each of the tanks, and an additional switch plate which holds the fuse and pilot light which goes on whenever the fuse is blown. There are also 10 push-button switches, one above each panel, which temporarily omits that circuit and that tank or tanks from service.

One of the tanks is reserved for emergencies leaving the remaining nine for normal production. With all nine tanks empty and all of the switches on the control board placed at automatic, the first tank fills to the predetermined level, then automatically shuts off and opens the valve, allowing the oil to flow into the second tank. As long as the tank is filling the center pilot light in the panel is on but as soon as the tank is full the right-hand pilot light comes on, indicating that particular tank is ready for gaging and discharge into the pipe line. As each of the remaining tanks is filled, the inlet valve shuts on that tank and opens the valve into the next empty one.

If one of the tanks in the battery is already full, the tank ahead of it is filled and then the full one is automatically skipped and the next empty one goes into service. If, for instance, the tanks 4, 5 and 6 were already full, tanks 1, 2 and 3 would be filled, the next three skipped and the production emptied into tank 7.

Board Shows Storage Situation

As soon as any tank is emptied, the left-hand light on the panel comes on so the pumper knows just which tanks are empty. By watching the control board, the pumper knows which tank is filling, which tanks are full, and which ones are empty.

There are cases where for some reason it is desired to skip one or more of the tanks in the battery for one cycle only. The push-button switch immediately above each panel throws that particular part of the system on to temporary "omit" and that tank will be excluded from the system for one cycle. On the next succeeding cycle it will automatically cut back in and will be filled in the normal order.

Exclusion of a particular tank or several of them from the system for major repairs or for any other reason is accomplished by throwing the switch on each of the desired plates to "omit" and that tank remains permanently out of the system until the switch is thrown to "automatic."

When all of the nine tanks normally used in the system are full the valves on all of them will be closed, but the pressure head in the header will cause the inlet valve on the auxiliary tank to open and a warning signal to be sounded. The pumper can then empty a tank into the pipe line or shut down the wells.

Being controlled by electricity, the system would not function if the current were cut off by a fuse being blown or a failure in the power source. In such cases the auxiliary tank is then opened to the line as the entry valve on it is held closed electrically and automatically opens whenever the current is cut off or fails. No warning is sounded, but as the current for operation of the controls is connected to the camp supply, a failure in the office and works lighting system shows that the control system is inoperative.

Pipe-line and Indian Agency regulations require that the switch controlling a particular tank be

thrown to the "omit," or out, position before the oil is run from the tank. As soon as the tank has emptied, the left-hand pilot light flashes on the board telling the pumper and gager that the tank is ready for gaging. The control switch is then returned to the automatic position, placing the tank back into the system.

Another pipe-line and Indian Agency regulation requires that a stopcock be located between the automatic switch and the tank and that this stopcock be sealed in the closed position while running oil from the tank. Failure to reopen the manual stopcock will result in throwing the system into "emergency" operation since the automatic valve opens, but entry to the tank is blocked. In that case the system atuomatically recycles itself, picking out the lowest-numbered tank in the system which is empty and filling it and all succeeding tanks which have storage space. This will be repeated until all tanks in the system are full in which case the pressure on the line builds up to open the auxiliary tank. As oil is admitted to the auxiliary tank the pressure drops and the valve again closes until there is again sufficient pressure to open it. This causes all of the lights on the control board to blink on and off, warning the pumper that the auxiliary tank is being filled. As the auxiliary is a 1,000-bbl. tank, from 5 to 7 hours' production can be handled before this tank would run over.

It is sometimes necessary to fill completely the auxiliary tank. To do this, it is only necessary to set the switch from "omit" to "automatic." The tank will fill, then recycle the system and start over. To drain the auxiliary tank, set the switch back to "omit," drain, and close outlet stopcock.

Operates on 115 Volts

The high limit and the cutoff control are equipped with the two switches so that if one should fail the other would operate and the system would continue to function. The second switch is not essential but is included in the system to make it more foolproof and to insure against failure.

Successful operation of a system of this type depends on the design and the appropriate use of the switches and the electrical equipment. The system operates on 115-volt alternating current. The liquid-level control switches are of simple design and work on the packless magnetic principle; no packing or stuffing boxes are involved and the switching action is performed by mercury switches.

The relay holding switches remain closed while the tank is full and will not reopen until the system recycles. The succeeding tanks cannot get any current to operate on until the preceding ones are full and the relay switches on them are closed. The above is actually a bank of holding circuit relays operated in positive sequence.

Recycling of the system is accomplished through a thermal relay which breaks the holding circuit in the relay switches and discontinues power to the circuits. The thermal relay then closes and current is again supplied to the system, the holding relays closing in succession until they are all closed, at which time the thermal relay again acts to break the circuit.

The system was built by the operator in conjunction with the Fred H. Schaub Engineering Co., Inc., of Chicago.

Left: Control board showing the individual panels with lights indicating whether the tank is filling, full or empty, the switch for putting the tank in or withdrawing it from the circuit and the temporary omit buttons

Below: Piping diagram of tank battery in the Burbank, Oklahoma, field with the location of automatic controls shown in left side of drawing. Wiring diagram for tank battery is shown at the right

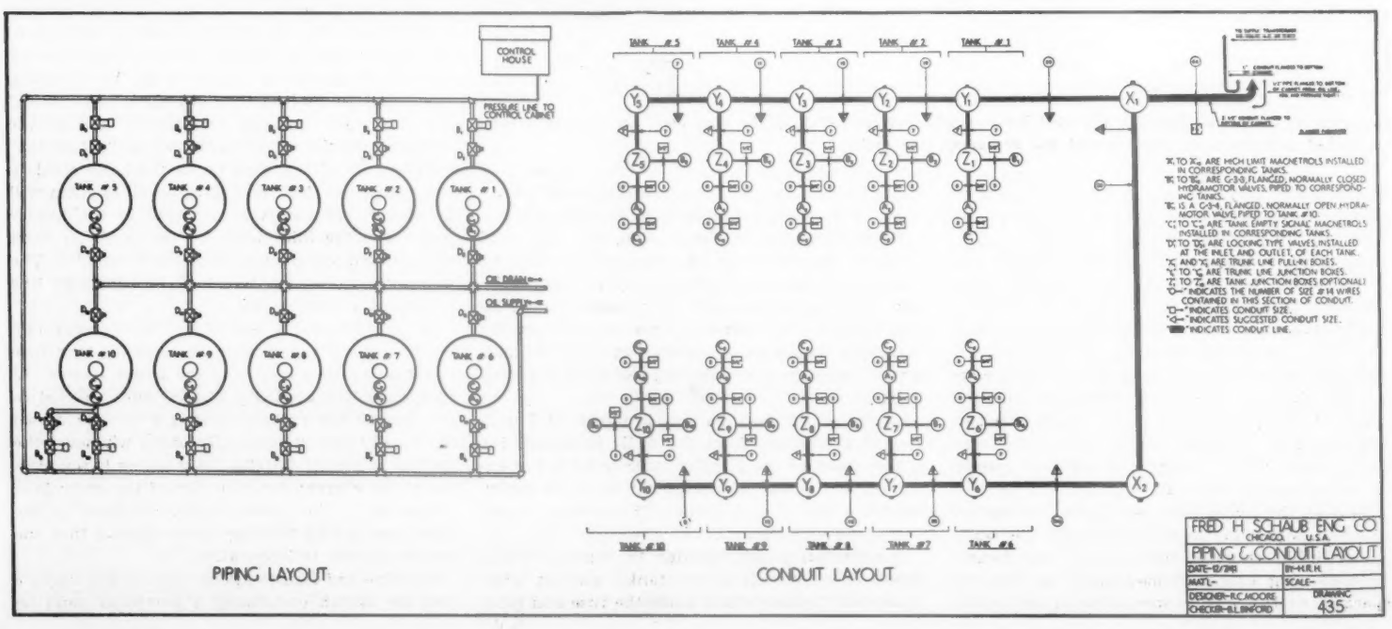
BOOKS

OIL WELL DRAINAGE, by Stanley C. Herold, petroleum geologist and production engineer, Los Angeles, Calif. Published by the Stanford University Press, $5 per copy.

This is a practical book written in an easily readable style and deals largely with field applications. The events and conditions within a producing reservoir are described and the influence of well performance on the movement of oil and gas is discussed. Included are the specific matters of drainage, such as radius, water encroachment, movement of oil and gas across property lines, effects of stratigraphy and structure, penetration, multiple zones, rates of production, and field development. Effect of injection, reservoir content, ultimate recovery, reserves, abandoned oil and gas, curtailment, proration, and conservation are also treated.

The book is planned for maximum reference value and the chapters are divided into two parts, one each for the two types of wells with distinct drainage features. Notations in the outer margins help the reader in finding the desired material.

The book is typical of university press publications in that it is an example of modern topography and excellent printing.



High Gas Pressures Controlled at Alice

By NEIL WILLIAMS

ABNORMAL gas pressures, among the highest yet recorded in the lower Texas Gulf Coast district, and caving shales combined to create unusually difficult conditions for Southern Minerals Corp. in the drilling of its 2 Stillwell, recently completed as the discovery well of Yegua production in the Alice field, Jim Wells County. On several occasions operators were threatened with serious blowouts and loss of hole, and in the completion of the well, the drill pipe, stuck by bridging and caving of the shales, was left in the hole because of the hazards involved in attempting to recover it under the existing high pressures.

The well is one which had been completed originally in November 1938 as a gas well from one of the regular sands of the field at 5,105-10 ft., where 7-in. casing, cemented at 6,430 ft., had been perforated opposite the sand. In exploration for possible productive horizons below the original total depth of the hole, the gas well was killed, and deepening of the hole started November 19, 1941, when the old guide shoe was drilled out.

When the original hole was drilled to 6,430 ft., considerable trouble had been experienced in making the last 600 ft. due to shale gas. However, the casing was run and cemented successfully providing adequate protection through that section, and in the new hole below the casing no trouble of consequence was encountered down to 6,888 ft., 458 ft. below the casing. There, in attempting to come out of the hole, the pipe stuck. On this occasion the pipe was pulled loose after several hours, and after conditioning mud and building up the walls of the hole, drilling again proceeded.

Drilling with approximately 12-lb. mud, another 225 ft. of hole was made to 7,113 ft., but there the 6,900-ft. section again started to give trouble. Because of the high pressures and caving shale several days were required for conditioning and circulating mud and building up the walls of the hole to a point that drilling could be resumed. Before resuming drilling, an electrical survey was run at 6,860 ft. and some side-wall samples were taken but no shows were indicated.

As the hole was deepened, a tight place at 6,860 ft. continued to give increasing trouble on round trips with the pipe. At 7,394 ft. a second electrical well survey was run from approximately 7,380 ft. At 7,448 ft., considerable high-pressure gas was encountered, cutting the mud. By conditioning the mud and building up the weight, the gas was controlled, and drilling continued. At 7,720 ft. the gas again started to give much trouble. The hole was carried to 7,767 ft., where it was necessary to condition the mud and add more weight. Pipe was pulled to run an electrical survey, but in going back in it was possible to get only to 6,500 ft. when the well started to head, and had to be shut in. While the well was shut in, the gas was bled off the casing at a pressure of 900 lb.

Finally able to pull the electrical surveying tool from the hole after the incompleted run, operators went back in the hole with the drill pipe, and succeeded in washing down to 6,860 ft. At that depth, however, the hole was in such bad shape it was considered necessary to sidetrack and start a new hole. Several days first were required to rebuild the walls of the hole in the section from the bottom of the casing to 6,860 ft.

Drilling in new hole, the well made strong heads of gas in a section at 7,437-70 ft. This was the same approximate section in which high pressures were combated in the first hole. By careful control over the mud, the hole was carried to 7,735 ft. At that depth the mud was thoroughly reconditioned preparatory to attempting to run another electrical survey, but before pipe could be pulled the well started blowing out.

Blowout-preventer rams were closed, holding the well, and the gas was bled off from the casing gradually. After the well had been shut in about 3 hours it was found that the drill-pipe had stuck. It was believed the well had bridged around 6,900 ft., at which depth a large cavity had resulted by the pumping of shale from that section while drilling.

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Attempts to loosen the pipe failed. First, 15.2-lb. mud was pumped through the drill pipe back into the formation under 1,000-lb. pump pressure. Weight of the mud was stepped up to 16 lb. without establishing circulation. Desiring to test the productivity of the 7,700-ft. horizon from which the well had blown out, it then was decided to attempt to complete the well through the drill pipe, and at the same time avoid the hazard of trying to cut out the pipe under the existing pressures.

The bit was calculated to be at a depth of 7,714 ft., which was believed to be about 5 ft. in the top of the sand section, and 21 ft. off bottom of the new hole.

Preparatory to attempting to complete the well, 770 sacks of cement were pumped between the drill pipe and the 7-in. casing, forcing the cement out below the bottom of the casing at 6,430 ft. and filling up around the outside of the drill pipe to the bottom of the blowout preventer on top of the 7-in. casing. With the upper portion of the preventer above the master gate removed, a christmas tree then was assembled on top and anchored, following which the rig was removed and a block of concrete was poured around the well. This block is 8 ft. square, and extends down below the top of the 10¾-in. surface casing and encasing the 7-in. casing to the bottom of the master gate forming an integral unit with well pipe and cement. This was a special precaution to prevent any possibility of well vibration and providing security against the pipe or connections working loose and permitting the well to blow out.

Opened, the well started cleaning itself, building up a pressure of 4,600 lb. within 15 minutes. It was permitted to clean itself through a small choke into a high-pressure separator. Closed in, the well built up a pressure of 5,100 lb. On a 24-hour production gage through a ⅛-in. choke, the well flowed 75.76 bbl. of light straw-colored distillate and 1,096,000 cu. ft. of gas with 37.38 bbl. of water, gaging 3,900 lb. working pressure.

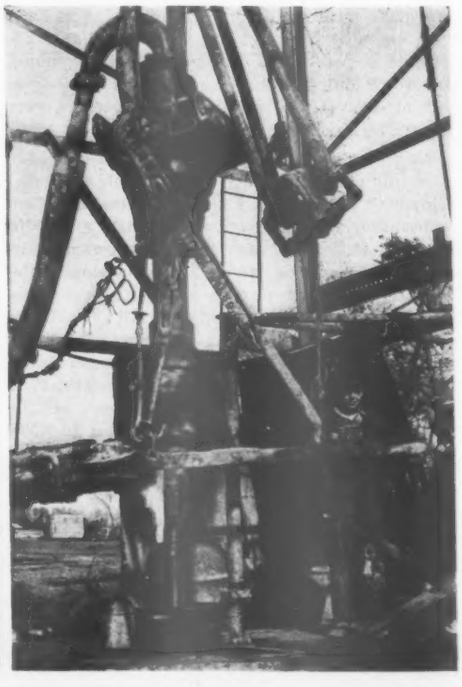
An analysis of the distillate showed it to be 49.6° A.P.I. gravity, having a yield of 42.5 per cent of 65-octane gasoline at 300 end point, and 63.7 per cent of 54-octane gasoline at 400 end point. Continued production tests have shown yields of approximately 61 per cent distillate and 39 per cent water with a gas-oil ratio of less than 10,000 cu. ft. per barrel of distillate. The color of the distillate indicates that there may be oil production in the reservoir at a different position on the structure. If this is a gas-producing horizon, the gas is extremely wet.

There are indications that the Yegua section was topped in this well at approximately 7,250 ft., with paleontology definitely showing the well to be in the Yegua at 7,425 ft., placing the bottom of the hole 310 ft. in the section.

Rope Use Found Convenient To Trip Hook Safety Latch

TO trip the safety latch on the drilling hook when releasing the swivel bail or the elevator links, customary practice is to use a pole, the latches being at a height beyond hand reach. This operation, although not frequently necessary, is sometimes slightly dangerous, as well as uncertain and inconvenient.

An ingenious drilling crew for a drilling contractor operating in the East Texas field has avoided this inconvenience by devising a means for tripping the latch with a rope. The rope is fastened to the latch so that a stiff pull will trip the latch to allow the swivel bail or elevator links, as the case might be, to slide off the hook. The rope is of such length that the crew man can stand back while releasing the latch, and thus be away from any danger.



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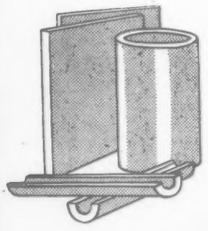

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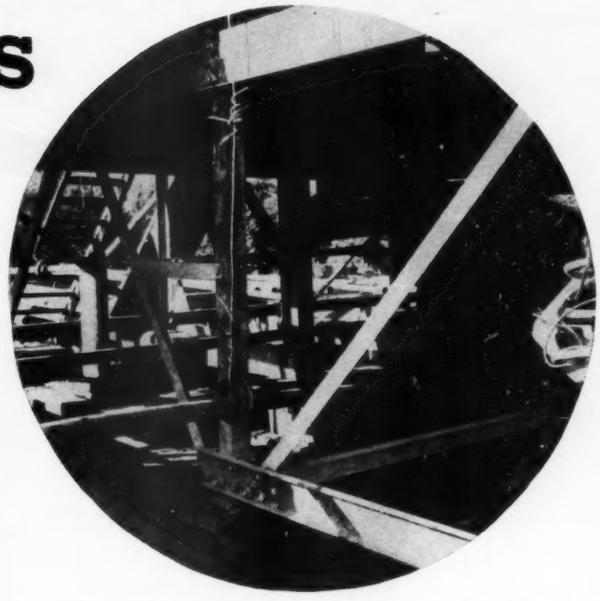
Operating Ideas

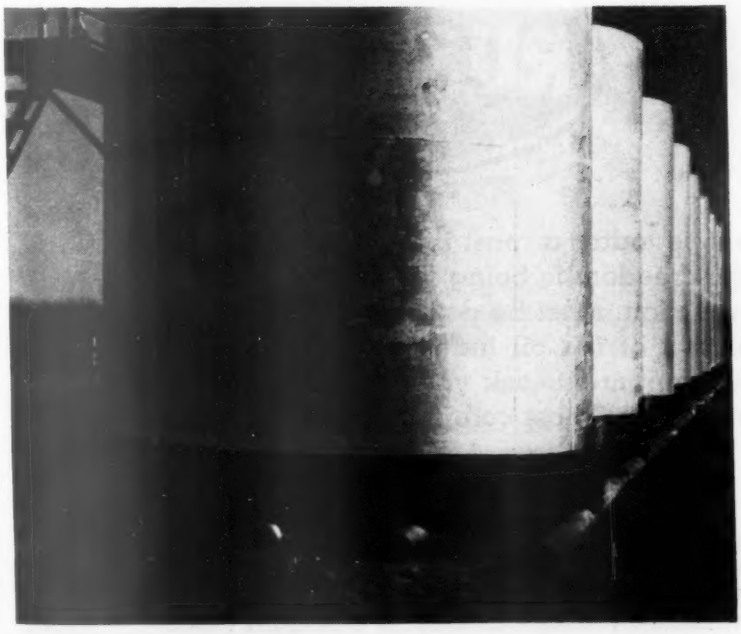
Belting Strip Reduces Light Vibration

Light fixtures suspended from any point on a derrick substructure or any lines carrying mud are subjected to severe vibration which greatly shortens bulb life and may result in light failure at a critical moment. To absorb much of this vibration, one company inserts a short length of Gandy or balata belting in the fixture from which the light is suspended. This flexible section breaks up the pulsations or vibrations, allowing the light fixture to swing slowly, or even to remain undisturbed entirely by the shaking of its supporting structure.



Flexible Suspension For Control Shaft

Suspending the blowout-preventer hand-wheel shaft in a wide ring which hangs from the derrick structure at the end of a short length of sand line enables the unit to swing freely and absorb the vibration of the derrick structure. Elimination of the pounding set up by the vibration of heavy hand control relieves the universal joints and control stem of the blowout preventer of much unnecessary wear. By changing the length of the line the hand-wheel assembly can be set at the most convenient operating level.

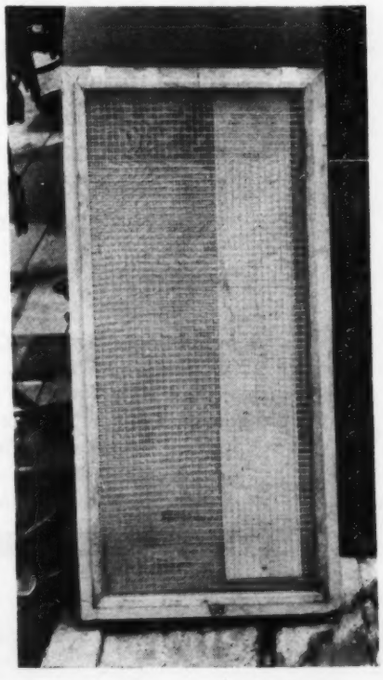


Tank Battery Base Made From Pipe

Reclaimed pipe is used for foundations for one tank battery in the Hull-Silk field, Archer County, Texas. Five sections of 6-in. pipe, laid lengthwise of the battery, provide the support. These are spaced uniformly and tied together with short sections of old 2½-in. tubing. Welded, the pipe forms an integral matting base, which can be moved easily if desired. The base is of such width that the side edges of the tanks rest on the outer lengths of 6-in. pipe. On the pipe, the bottoms of the tank do not touch the ground, and are thus protected from ground corrosion.

Bulletin Board For Drilling Rigs

The number of important papers which must be kept around a drilling rig is constantly increasing. Some states require posting of drilling permits, legal notices affecting insurance, unemployment compensation, and similar papers. Also, some companies furnish generalized logs of the region in which the drilling is taking place. One Illinois drilling contractor has equipped his rigs with a special bulletin board for such papers. They are made from plywood in the usual manner, but instead of having a glass front, which might be broken easily, or not having any front, which would leave the notices without protection, a heavy screen wire is used in the door. This allows the notices to be read easily, and their removal is only a matter of raising the door.



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CO$T Engineering

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL

REPLACEMENT

MARCH 26, 1942

REPLACEMENT CALCULATION USING SINKING FUND DEPRECIATION

ONE of the most difficult problems that faces the production engineer is deciding when to replace equipment and the amount of money which must be set aside for replacement at some future date. Obviously, there are cases when there is little latitude granted. Either a new piece of equipment must be purchased or the operation must be interrupted. There are also times when the proper decision is obvious, as the inefficiency, high operating cost, or the necessity of major repairs might definitely indicate that a new engine is needed.

There are other cases which are borderline and it is difficult to determine at first glance whether a replacement should be made. In such cases, a reliable method of calculation is essential.

Any method used will depend to a great extent on the estimation of the useful life of the particular piece of equipment involved. There is a wide variation in the service secured from identical pieces of equipment by different operators and by the same operators on different leases. This leads to the use of an average figure.

The accompanying calculation is for an engine but the method used applies alike to all items of equipment. Knowing the original value of the old engine, its anticipated useful life, present age, salvage value and operating cost it is possible to determine mathematically whether the replacement should be made at a particular time.

OLD ENGINE

Engine age	5 years
Cost new	$7,200
Assumed working life	15 years
Salvage value	$500
Present sale price	$3,500
Annual operating cost for next 5 years is:	
First year	$2,800
Second year	$3,200
Third year	$3,800
Fourth year	$4,650
Fifth year	$5,500

NEW ENGINE

Cost new	$12,000
Assumed working life	15 years
Salvage value	$800
Annual estimated operating expense	$3,600

At an interest rate of 5 per cent compounded annually the present value of 5 years operating cost for the old engine is:

$$\$2,800 \times \$1.05^4 + \$3,200 \times \$1.05^3 + \$3,800 \times \$1.05^2 + \$4,650 \times \$1.05 + \$5,500 \times 1 = \$21,680.$$

The amount annually placed at r compound interest for n years which will mount to 1 can be obtained by the formula:

$$\frac{r}{(1+r)^n - 1} = \frac{0.05}{(1.05)^5 - 1} = 0.18$$

The annual equated operating cost of the old engine then becomes $21,680 × $0.18 = $3,900.

$$\text{Annual sinking fund factor} = \frac{0.05}{(1.05)^{15}} = 0.047$$

Sinking fund annuity old engine = ($7,200 — $500) 0.047 = $315

$$\text{Present accumulation of annuity of } 1 = \frac{(1.05)^5 - 1}{0.05} = 5.56$$

Present value of sinking fund set aside for engine depreciation = $315 × 5.56 = $1,750

Depreciated value old engine = $7,200 — $1,750 = $5,450

Difference between this and sale price = $5,450 — $3,500 = $1,950

Actual investment required for the purchase of the new engine then becomes: $12,000 + $1,950 = $13,950

Annual sinking fund payment = ($13,950 — $800)$^{0.047}$ = $618

Annual cost = sinking fund annuity + interest + operating cost

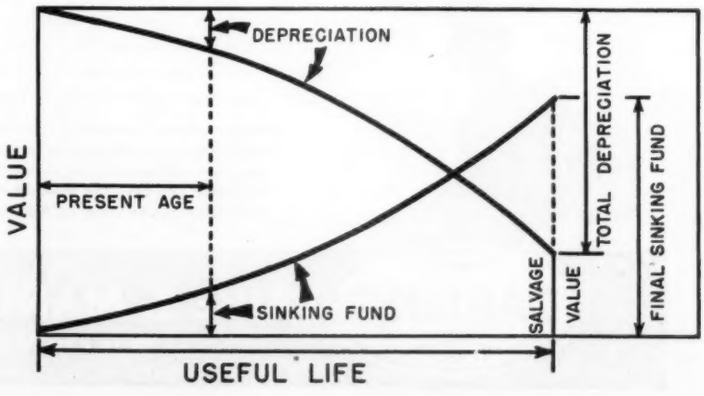
Annual cost old engine = $315 + $7,200 (0.05) + $3,900 = $4,575

Annual cost new engine = $618 + $13,950 (0.05) + $3,600 = $4,914

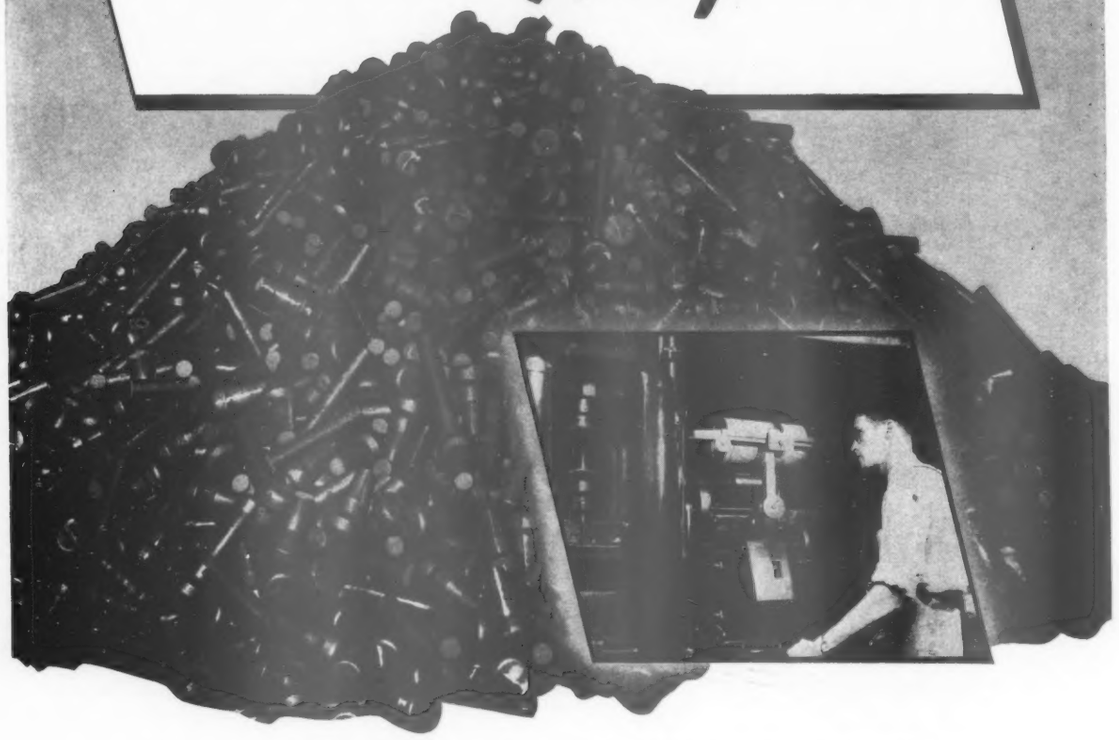
Difference in annual cost = $4,914 — $4,575 = $339

It would seem inadvisable at this time to purchase the new engine as the old engine can be operated at a yearly saving of $339.

There are other considerations which necessarily enter into the picture when considering such a change. For instance, there may be some place where the old engine could be used to advantage at a reduced load and its life extended. Changing horsepower requirements might also influence the decision. Without such contributing factors and basing the decision on the facts outlined above the economics of the situation is in favor of retention of the present equipment.



No Shortage in *Widgets!*



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CO$T Engineering

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL

GAS DRIVE

MARCH 26, 1942

GAS-DRIVE EFFICIENCY DETERMINED BY INJECTION RATIO

PARTICULARLY useful because of its simplicity and ready interpretation is a little "limit gage" that can be applied for cost control in stripper drive operation.

Whether gas, air or their mixtures may be used, a unit cost will be known for the drive medium delivered to the formation. The case of purchase of drive-gas service at a flat unit rate affords the essence of simplicity; but any other source cost can and should be definitely determined.

Gas may be available on the property, but in a different horizon from that to be pressured. It may be available at drive pressure required, or it may require boosting by compressors to do the job. The available source often is casing-head gas, which should be gathered and used. In many such instances, enough condensate (drip) will be stripped and delivered to the crude stock, or sold otherwise, to provide compressor maintenance and operating expense, and often to retire compressor investment and liquidate entirely the gas-cost factor involved in the drive. A unit cost factor can usually be found readily enough.

Call this unit, 1,000 cu. ft., *C*.

Assume such a unit to be $0.035.

The universally accepted method of evaluating results of the gas-drive, secondary-recovery detail is the simple graphic log of performance.

It is necessary to resort to extrapolation of decline rates to provide the factors to use in the simple cost "limit gage." In the case of stripper wells, or in the settled classification of 3 to 5 years, extrapolation can be applied to predict with surprising accuracy the future production trend, at least for some years, merely by continuing the method already applied.

Where past performance time factor is insufficient, excellent results can be had by referring to and using data available from similar structural and reservoir characteristics.

There is submitted for explanatory reference, a graphed log of the simplest kind. If such records of actual performance be kept, accurately and carefully prepared, the results can be read at a glance to any sufficient degree required to the following ends:

1. Is the cost of applied drive medium approaching a limit which will leave no profit after other cost factors have been set aside?

2. From inspection of results logged thus far, what conclusions may be derived as related to effective results;

Some examples of Case 1 follow:

Assume the graph to be built on daily averages of 1-month time intervals, *A*, being extrapolated, *B*, actual oil production, and *C*, unit volume gas injected. It will be seen that at the end of the first month the graph could not be read within any degree indicative of effect varying from normal expectation; nor would a variance of a small fraction of a barrel per day be indicative of any other control factors, outside of the drive being applied, if such variance were noted from book record of runs.

Passing to the end of the second month, the result may be read as definitely indicative of drive effect, that is for the long-established stripper that can be expected to perform at least within ¼-bbl. daily variance from week to week.

Advance further, to point *C*. Here the gas volume is 23. Note that production has increased to the rate *B*, or 11 bbl. Since the rate would have been *A*, 7.8, without deviation from predrive method, take $0.035 times $\left(\frac{C}{B-A}\right)$, and obtain $0.1644. This is the price times the unit cost of the drive gas, as read from the graph; $C = 23{,}000$, $B = 11$, $A = 7.8$, and the factor which can always be used as a limit gage is the $\left(\frac{C}{B-A}\right)$, or 5.48 M.c.f. gas indicated for each barrel of drive-effect oil produced. This may be termed "IR," injection ratio.

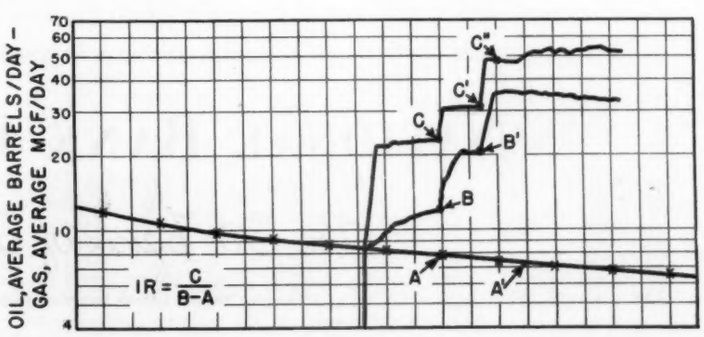
Now examine developments related to Case 2.

Passing over time interval to point *C'*; the data indicated may result from increased volume input into a single well, addition of an input well or, for instance, application initially of vacuum. Now it is seen that $\left(\frac{C'}{B'-A'}\right)$, or $\left(\frac{32}{20-7.6}\right) = 2.58$ M.c.f.

In gas-drive dollar terms, the drive-effect oil is now costing only $0.0903 per barrel.

Further exploring the curve to point *C'''*, in similar manner it is found that the injection ratio is 1.75 M.c.f., and as this is good performance, stabilization of the operation may be expected.

At the end of another year or so, indications will confirm the conclusion that satisfactory efficiency has been reached; trends will have become stabilized at new levels and future performance over periods of a few years may be predicted with such close approximation as to be quite satisfactory as a basis for estimations of revenue.



Prepared by Frank P. Peterson

DEVOTED TO COST ESTIMATIONS, OPERATING CALCULATIONS AND PROFIT MAKING

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Engineering Fundamentals

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL NO. 4

MARCH 26, 1942

DENSITY OF OIL-FIELD LIQUIDS

THE density of a substance is the weight of that substance per unit of volume. Common units of density are: pounds per cubic foot, pounds per gallon, and grams per cubic centimeter. Indirectly, the density of liquids are often expressed in terms of specific gravity, A.P.I. gravity, and Baume gravity. An explanation of these various liquid-density units will be given in this installment.

Previously in this series we have used 62.4 lb. per cu. ft. as the density of water. This value is accurate enough for most purposes if the water is at ordinary atmospheric temperature. As shown by Table 1, water has this density at about 50° F. At temperatures lower than 50° F. the density becomes progressively greater, and at higher temperatures the density progressively decreases. This may make it necessary to consult a table similar to Table 1 if one is making calculations in which the density of water at temperatures widely separated from 50° F. are involved.

Density of liquids other than pure water are often expressed indirectly as specific gravity. The specific gravity of a liquid is the ratio of the weight of a given volume of that liquid to the weight of an equal volume of pure water.*

The density of salt water produced from oil wells may be considerably higher than the density of fresh water. This is due to the great quantity of dissolved mineral matter or salts in the oil-field water. It is not uncommon for an oil-field brine to have a specific gravity in excess of 1.1. In making calculations regarding collapse of casing in wells, common practice is to use 0.5 lb. per sq. in. per 100 ft. of depth as the pressure gradient of salt water. Such a figure is based on the assumption of 1.15 as the specific gravity of salt water.

The density of oil, or of any other liquid, may be determined by direct weighing of a given volume. However, oil densities are not generally determined in this manner. The density of an oil is most commonly determined indirectly by measuring the A.P.I. gravity. A.P.I. gravity is an arbitrarily chosen scale based on the following formula:

$$\text{Specific gravity} = \frac{141.5}{131.5 + \text{A.P.I. gr.}}$$

or

$$\text{A.P.I. gr.} = \frac{141.5}{\text{specific gravity}} - 131.5$$

It should be noted that if a specific gravity of 1.00 were substituted in the above formula, the A.P.I. gravity obtained would be 10.0. Thus, the A.P.I. gravity of pure water is 10.0. By examining Table 2, one can see the relation between A.P.I. gravity, specific gravity and density in various units. It should be noted that liquids of greater density and specific gravity have lower A.P.I. gravity, and, conversely, a liquid of lower density and specific gravity has a higher A.P.I. gravity.†

The A.P.I. gravity of an oil is measured using a hydrometer, which is an accurately calibrated glass tube with a small graduated stem at the top and a larger bulb at the bottom. Some lead shot are placed at the bottom in order to insure a vertical position of the instrument when it is floating in the oil. The graduated scale is so arranged on the stem that the reading at the liquid level is the A.P.I. gravity of that particular liquid. This reading may be converted directly by use of the formula above to obtain the specific gravity of the oil at observed temperature. In purchases of crude oil, most pipe-line companies have a price scale based on gravity and pay higher prices for the oils of higher A.P.I. gravity, since the higher gravity indicates a larger proportion of gasoline fractions in the crude oil. In order that A.P.I. gravity may be a true indication of relative gasoline content in various oils, it is necessary that the temperature effect upon gravity be eliminated by correcting the gravity readings from observed temperature to standard temperature. For some calculations, however, it is desirable to know the actual density of the oil under conditions of the test. In such a case, the gravity of oil should not be corrected to 60° F.

*For extremely accurate work it is necessary to consider the temperature at which the densities of the liquids are compared. However, for most practical purposes consideration of this fact is unnecessary.

†The old Baume scale is based on the formula:

$$\text{Specific gravity} = \frac{140}{130 + \text{Baume gravity}}$$

This scale has now been almost universally replaced by the A.P.I. gravity scale.

TABLE 2—RELATION BETWEEN VARIOUS OIL-DENSITY UNITS
(Based on water density of 62.4 lb. per cu. ft.)

A.P.I. grav.	Specific grav.	Lb. per cu. ft.	Lb. per gal.	Lb. per bbl.	Lb. per sq. in. per 100 ft. of depth
10	1.000	62.4	8.34	350.28	43.3
15	0.966	60.28	8.06	338.52	41.8
20	0.934	58.28	7.79	327.18	40.4
25	0.904	56.41	7.54	316.68	39.1
30	0.876	54.66	7.31	307.02	37.9
35	0.850	53.04	7.09	297.78	36.8
40	0.825	51.48	6.88	288.96	35.7
45	0.802	50.04	6.69	280.98	34.7
50	0.780	48.67	6.50	273.00	33.8
55	0.759	47.36	6.33	265.86	32.9
60	0.739	46.11	6.16	258.72	32.0

TABLE 3—RELATION BETWEEN SPECIFIC GRAVITY AND OTHER DENSITY UNITS APPLICABLE TO OIL-FIELD BRINES

Specific gravity	Lb. per cu. ft.	Lb. per sq. in. per 100 ft. of depth
1.01	63.0	43.7
1.02	63.6	44.2
1.03	64.3	44.6
1.04	64.9	45.0
1.05	65.5	45.5
1.06	66.1	45.9
1.07	66.8	46.3
1.08	67.4	46.8
1.09	68.0	47.2
1.10	68.6	47.6
1.11	69.3	48.1
1.12	69.9	48.5
1.13	70.5	48.9
1.14	71.1	49.4
1.15	71.8	49.8
1.16	72.4	50.2
1.17	73.0	50.7
1.18	73.6	51.1
1.19	74.3	51.5
1.20	74.9	52.0

TABLE 1—WEIGHT OF WATER PER CUBIC FOOT AT VARIOUS TEMPERATURES

Temperature, °F.	Weight per cubic foot, lb.	Temperature, °F.	Weight per cubic foot, lb.	Temperature, °F.	Weight per cubic foot, lb.	Temperature, °F.	Weight per cubic foot, lb.	Temperature, °F.	Weight per cubic foot, lb.
32	62.42	150	61.18	260	58.55	380	54.36	500	48.7
40	62.42	160	60.98	270	58.26	390	53.94	510	48.1
50	62.41	170	60.77	280	57.96	400	53.5	520	47.6
60	62.37	180	60.55	290	57.65	410	53.0	530	47.0
70	62.31	190	60.32	300	57.33	420	52.6	540	46.3
80	62.23	200	60.12	310	57.00	430	52.2	550	45.6
90	62.13	210	59.88	320	56.66	440	51.7	560	44.9
100	62.02	212	59.83	330	56.30	450	51.2	570	44.1
110	61.89	220	59.63	340	55.94	460	50.7	580	43.3
120	61.74	230	59.37	350	55.57	470	50.2	590	42.6
130	61.56	240	59.11	360	55.18	480	49.7	600	41.8
140	61.37	250	58.83	370	54.78	490	49.2	...	...

From "National Pipe Standards," National Tube Co.

Series prepared by Glenn M. Stearns, associate professor of petroleum engineering, University of Oklahoma

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Engineering Fundamentals

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL NO. 5

MARCH 26, 1942

CONTROL OF MUD-FLUID-COLUMN PRESSURE TO SUBDUE FORMATION PRESSURE

In certain drilling wells high gas and water pressures are often encountered in the formations penetrated by the bit. In order to proceed with the drilling and completion of a well without damage to the personnel, equipment, or well bore itself, it is necessary to subdue such natural formation pressures. Blow-outs, particularly those resulting from high gas pressures encountered, have been costly to life and property.

In rotary drilling wells the pressure of the column of mud fluid in the hole is depended upon as the principal means of controlling such formation pressures. This is done by maintaining a drilling fluid of such density that the pressure exerted by the drilling fluid column will exceed the expected formation pressure by a sufficient amount to eliminate the possibility of a blow-out.

In many proven areas it is found that a column of water is sufficient to control any pressure that is encountered, so that no particular attention need be given to the maintenance of mud density. In wildcat drilling, however, it is necessary to give more attention to this factor. Generally speaking, a pressure gradient in excess of 43 or 44 lb. per sq. in. per hundred feet of depth would not be expected. There are notable exceptions, however, as in the Permian Basin of West Texas and Southeastern New Mexico for example.

Drilling crews, especially in unproven territory, must exercise extra precaution to prevent the occurrence of any blow-out that could possibly be prevented. To take care of the possibility of any particular wildcat having an exceptionally high pressure at a given depth, blow-out prevention equipment may be used on the wellhead, or a mud may be used of sufficiently high density to insure that the mud column pressure exceeds the formation pressure by a sufficient margin even if the latter is abnormally high.

A mixture of clay and water can be made sufficiently dense to control formation pressure in many cases. It has been learned by experience, however, that such mixtures become too viscous to be pumpable if the clay is added in large enough proportions to produce a density of the drilling fluid greater than about 11.0 lb. per gal. To obtain a drilling fluid of greater density, it is necessary to add finely ground heavy minerals. Barite and iron oxide are the heavy minerals commonly used for this purpose. Barite is generally preferred because some varieties of iron oxide are gritty, causing abrasion of slush pumps, swivel, and drill pipe. It is possible also that iron oxide promotes oxidation of any iron or steel equipment with which it comes in contact. By use of clay alone or in combination with heavy minerals, it is possible to maintain the density of a mud anywhere between a value equal to the density of water, 8.34 lb. per gal., and a value about twice the density of water, 17 lb. per gal.

The limiting condition that prevents increasing the density of mud to a value greater than 17 lb. per gal. is the accompanying increase in the mud viscosity. As the content of solids in a mud is increased in an effort to increase density, the viscosity of the mud also rises. To maintain the density even as high as the maximum mentioned, chemical treatment must be applied to the mud to keep it "thin" enough to be pumpable. Tannin and the "complex phosphates" are commonly used as viscosity-reducing agents, or mud thinners.

Two types of illustrative problems will be solved:

1. Calculation of pressure exerted by drilling mud of a given density at the bottom of a well of given depth when the well is filled with such mud.

2. Calculation of mud density required to control a given formation pressure at a given depth with some arbitrarily selected margin of safety.

Example 1.

Problem.—What pressure would be exerted at the bottom of a 4,500-ft. rotary well during drilling if the mud density were 9.2 lb. per gal?

Solution.—As explained previously, in Installment 2, a column of fresh water 1 ft. high exerts a pressure of 0.433 lb. per sq. in.

Then, a column of water 4,500 ft. in height would exert a pressure of $0.433 \times 4{,}500$, or 1,948 lb. per sq. in.

Water weighs 8.34 lb. per gal. (Table 1—Installment 1.)

This mud has a specific gravity of 9.2/8.34, or 1.1.

That is, the mud is 1.1 times as heavy as pure water.

Then, the pressure exerted by the 4,500-ft. column of mud would be 1.1 times that exerted by a like column of fresh water, or $1.1 \times 1{,}948$, or 2,143 lb. per sq. in.

Example 2.

Problem.—In drilling a rotary well, a formation pressure of 3,600 lb. per sq. in, is expected at a depth of 6,500 ft. If it is desired to maintain a margin of safety in favor of the mud column of 300 lb. per sq. in. At what value should the density of the mud be maintained?

Solution.—It is desired that the mud column exert a pressure of $3{,}600 + 300$, or 3,900 lb. per sq. in. This would be the equivalent of $3{,}900 \times 144$ or 561,600 lb. per sq. ft.

Now if we imagine a column of the mud fluid 6,500 ft. in height and one square foot in cross-section, each foot of height would represent 1 cu. ft. of volume and the whole column must weigh 561,600 lb. So, 561,600/6,500, or 86.4 lb. per cu. ft., is the density of mud required to suit the conditions.

In units of pounds per gallon this density would be 86.4/7.48*, or 11.55 lb. per gal.

In a later installment, calculations will be made illustrating a method used to determine accurately the amount of clay or heavy minerals of a given specific gravity or density that must be added to a mud circulating system at a well to produce a final mixture of required density to control a certain formation pressure at some particular depth.

(*There are 7.48 gal. in 1 cu. ft. Example 7, Installment 1).

Series prepared by Glenn M. Stearns, associate professor of petroleum engineering, University of Oklahoma

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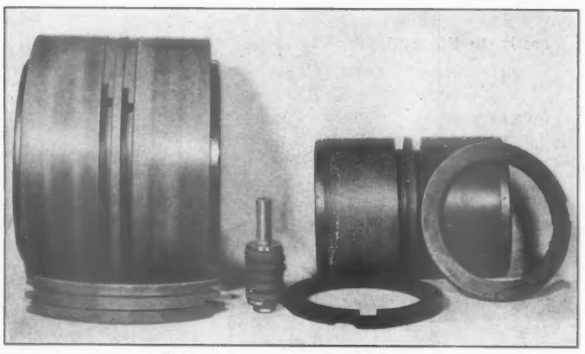

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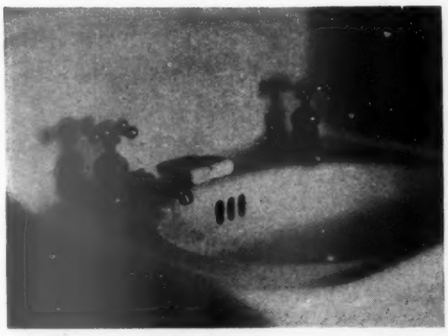
SAFETY - Metal Handles Prevent Hand Injuries

ONE of the great industrial hazards is dermatitis, which often causes an employe to lose time and in some cases has resulted in amputation or death due to infection. The most obvious preventive is ample provision for cleanliness and a supply of high-quality soap which does not irritate the skin.

Temporary or migratory installations (such as drilling rigs) must of necessity have rather crude or rudimentary facilities for washing. The more permanent plants, refineries, recycling, and gasoline plants and some production-department headquarters can and often do have washing facilities comparable with an upper middle-class home.

Oddly enough, providing the means for combating one evil may introduce another. In the elaborate, tiled wash rooms, the scheme is carried to the fixtures which are equipped with porcelain handles. These are broken by being struck with some object or by too much pressure being applied when attempting to shut off the water.



Cause of Accidents

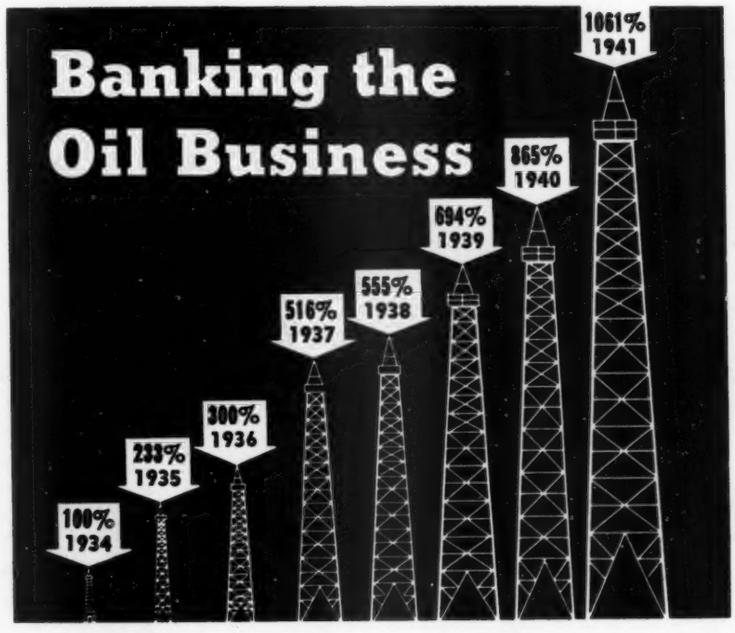
"A surprisingly large number of accidents are caused every year by porcelain handles on water faucets," J. E. Nichols, M.D., a Los Angeles physician, recently said. "The accident, which has become typical in my experience, occurs when a strong man grips a porcelain faucet handle to stop a drip. In turning it, the handle breaks, and the sharp edges usually sever the taut tendons of one or more fingers. Very little can be done for the patient in most cases, and the result is loss of use of fingers, or of the entire hand.

"If," continues the doctor, "your plumbing is fitted with porcelain handles, I advise frequent replacement of faucet washers so that little torque is required on handles to obtain complete shutoff. Frequent inspection of the porcelain is also helpful, as it is probable that the material must first be cracked before it can fail under manual pressure. Long ago, after treating several victims of this type accident, I threw all porcelain faucet handles in home and office into the discard and replaced them with metal handles."

Determining Angle For Mitered Joints

Mitered joints for welded pipe elbows can be marked off easily with a tub of water and a level protractor. To do this, submerge the end of the pipe under water at half the desired angle of bend. The level protractor is used to measure the angle. A mark around the pipe at the water level, or parallel to it, shows where the cut is to be made.

If the bend is to be made with more than two sections, the angle for each cut can be determined by dividing the total angle of bend by one less than the number of sections times two.



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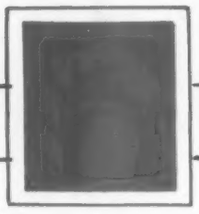
THE EFFICIENCY OF THE WHOLE  *IS DETERMINED BY ITS PARTS*

Check the Components of Your Plant

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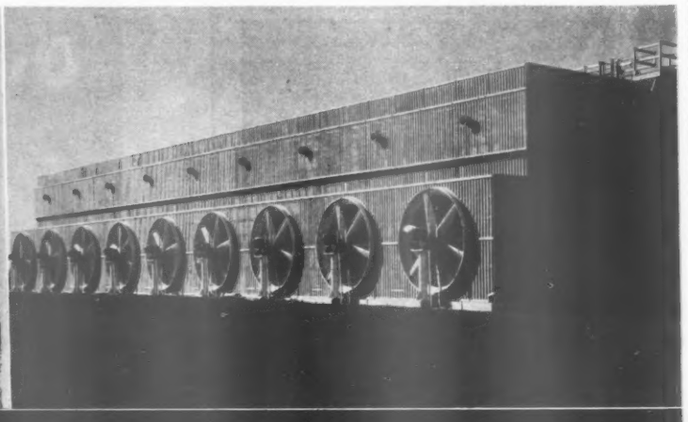

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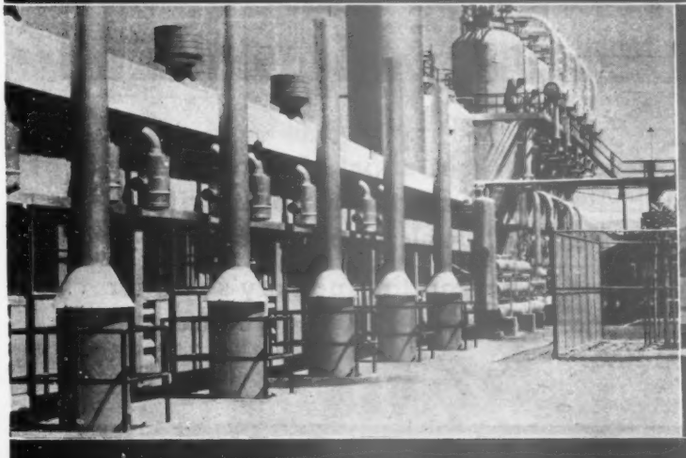

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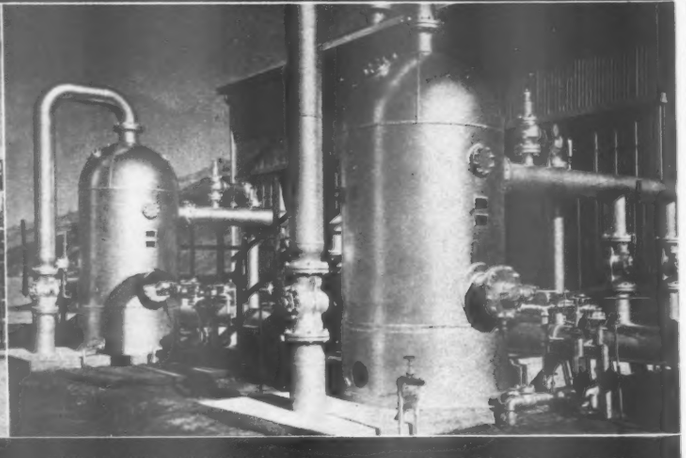

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REFINERY ACTIVITY AND EXPANSION

Port Arthur, Tex., Refinery Shipments Fall 40 Per Cent

PORT ARTHUR, Tex. — February shipments from Port Arthur's two refineries, Texas Co. and Gulf Oil Corp., declined approximately 40 per cent in February compared with January loadings. This is an indication of the extent to which coastwise movement of petroleum was depressed that month by the submarine attacks concentrated on oil tankers.

Shipments by the Texas Co.'s refinery in February declined to 3,211,680 bbl., a reduction of nearly 43 per cent compared to 5,632,534 bbl. loaded there in January. Gulf's refinery shipped 2,180,086 bbl., a decline of nearly 38 per cent compared to 3,504,835 bbl. in January.

Work Starts on $3,000,000 Aviation-Gasoline Project

PORT ARTHUR, Tex., Mar. 24.—Work was under way here today on a $3,000,000 aviation-gasoline unit at the Port Arthur plant of the Gulf Oil Corp. The project is part of a general expansion program at refineries in this area expected to total nearly $40,000,000 within the next 14 months.

Gulf's new unit, being built by the Lummus Co. of New York, is expected to double the local plant's capacity to make 100-octane fuel, increasing it to around 4,000 bbl. daily.

Canada's Synthetic Rubber Plans Based on Sarnia Refinery

OTTAWA, Ont.—C. D. Howe, minister of munitions, has made public some details of the Canadian synthetic-rubber project, which will be handled through Polymer Corp., Ltd., a government-owned corporation. Col. Arthur L. Bishop will be president, and the company will have its headquarters at Toronto. Four plants are expected to be required for the three steps in the manufacturing process, the initial process being handled by a plant in southwestern Ontario, probably at Sarnia, where Imperial has a large refinery.

Work has been started on plans and specifications, and it is expected production will begin some time in 1943. Capacity output of the plants will be around 34,000 long tons per year.

The product will be Buna rubber, utilizing butadiene and styrene.

Grease and Lubricating-Oil Additives Under Restraint

WASHINGTON, D. C.—Use of certain additives in the manufacture of lubricating oils and greases for passenger cars and other light motor vehicles in nonessential service will be prohibited after April 6. Recommended restraints in the use of certain chemicals were outlined by the Office of Petroleum Coordinator after the War Production Board issued instructions to reduce the use of the additives as much as possible.

After April 6 the use of additives in the manufacture of lubricating oils and greases will be restricted as follows:

Cresol: Lubricants containing additives requiring cresol must be designated not for passenger-car use.

Detergent or detergent disperser-type additives: Lubricants containing must be marked not for passenger-car use.

Oxidation inhibitors: Use of these additives to be reduced as much as possible.

Pour-point depressants: Use to be reduced by (a) maximum utilization of dewaxing facilities; (b) pour points revised upward to meet temperature requirements of each locality.

Extreme-pressure lubricants: These lubricants to be marked not for passenger-car use and a straight mineral-oil lubricant substituted. Chlorine is eliminated in the manufacture of chassis lubricants. All-purpose type lubricants are to be eliminated where possible.

All manufacturers of lubricating oils and greases are required to report within 45 days, the saving of additives under the recommendation.

Phillips Adding 200 Technical Men to Prosecute Rubber Plans

BARTLESVILLE, Okla. — Two hundred chemists and technical men are being added to Phillips Petroleum Co.'s personnel here in connection with the company's expansion of synthetic-rubber research and production.

The Phillips company owns a half interest in the Hycar Chemical Co. which has tripled the capacity of its polymerization facilities and is now building a new plant for the Government.

Louisiana Group Acquires Refinery at Arp, Tex.

TYLER, Tex.—Independent Refining Co.'s 4,000-bbl. plant at Arp, Tex., has been acquired by a group of Shreveport, La., oil men, headed by Fred Sklar, who is associated with the Louisiana Iron & Supply Co.

The Cardova gathering system, consisting of 50 miles of field connecting lines and handling from 2,500 to 3,000 bbl. a month, was also purchased.

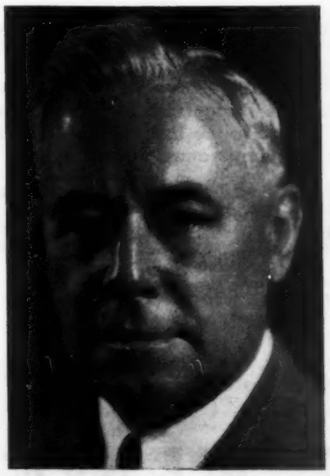
Petroleum Chemists Arrange For 13 Technical Papers

Thirteen papers have been arranged for the meetings of the Petroleum Division of the American Chemical Society which holds its 103 annual meeting in Memphis, Tenn., April 20-24. Dr. J. K. Roberts of Chicago, director of research of the Standard Oil Co. (Indiana), is chairman of the Petroleum Division and will preside at meetings of this section.

"Substitute Fuels, a War Economy of World Dimension" will be the theme of a discussion by Dr. Gustav Egloff and P. M. Van Arsdell of Universal Oil Products Co., Chicago. Dr. Benjamin T. Brooks, consulting chemist of New York City, will speak on "Thirty Years of Petroleum Research."

Julian G. Ryan of the Shell Oil Co., Wood River, Ill., will report on "Influence of Sulfur Compounds Upon Octane Number and Lead Susceptibility of Gasoline." G. H. von Fuchs and H. Diamond, also from the Shell laboratories, will dis-

Sketches of Plant Operators . . .



FRANK E. HOLSTEN, executive vice president of the Chalmette Petroleum Corp., learned the fundamentals of petroleum refining in the eastern part of the United States and then went west to apply that knowledge in the operation of several plants. Born in Brooklyn, N. Y., he graduated from Rutgers University and then went to work at the Bayonne, N. J., refinery of the Tide Water Oil Co. in 1905. He became chief chemist of the Tide Water plant before he left for Oklahoma in 1914 to become chief chemist at the Sand Springs refinery of the Pierce Oil Corp. He served as plant superintendent in 1917-18.

In 1918 Mr. Holsten was appointed process and general superintendent of the West Tulsa refinery of Cosden & Co. which was rapidly expanding its refining operations at that time.

Mr. Holsten left the Cosden organization in 1921 to accept the position of vice president in charge of refining of the Barnsdall Refining Co. He continued in that position until 1939, a period which saw the expansion of the company's refining operations from 1 to 3 plants including the construction of a new plant at Corpus Christi, Tex. He became executive head of the Chalmette operations in 1939. The company's refinery is located at Chalmette, La.

Mr. Holsten's hobby is sports. Many of his golf opponents will testify that his proficiency in golf has passed the hobby stage. The primary interest of the Holstens has been the rearing of five children—two daughters and three sons. Their residence is 223 Audubon Boulevard, New Orleans, La.

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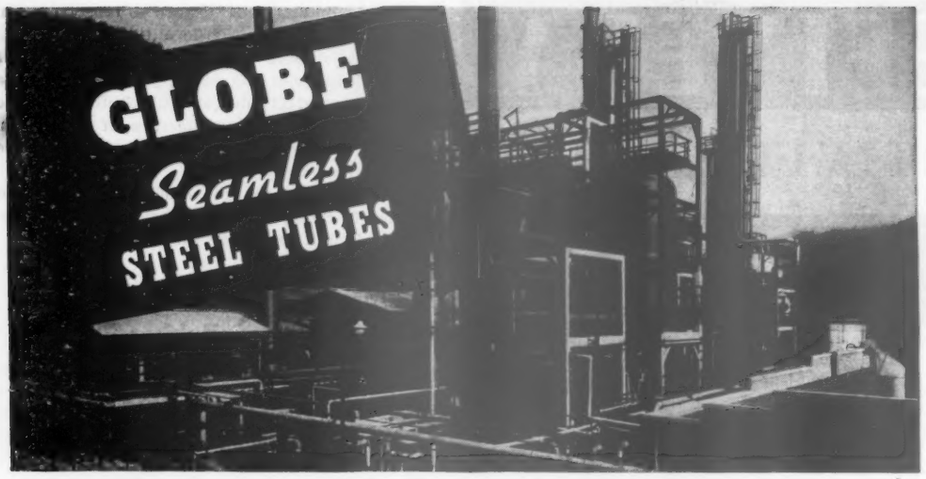

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cuss "Oxidation Characteristics of Lubricating Oils." Other speakers are: O. L. Polly, A. C. Byrns, W. E. Bradley of the Union Oil Co., Los Angeles, Calif.; E. C. Knowles, F. C. McCoy, Karl Uhrig, Harry Levin, and B. R. Stanerson of the Texas Co., Beacon, N. Y.; George Hulla, Jacque C. Morrell and R. C. Kuder of Universal Oil Products Co.; A. E. Hirschler, Sun Oil Co., Norwood, Pa.; F. Drew Mayfield, Phillips Petroleum Co.; George Wash, W. O. Ney, Jr., W. Crouch, and H. L. Lochte of the University of Texas.

WHO'S WHO IN REFINING

Union Oil Co., of California

THE Union Oil Co. of California explained in its 1941 annual statement, released last week, that the company last year spent $7,500,000 at its three refineries. The detail of these expenditures indicates the task ahead of the refining industry generally in supporting the war program with essential products and in continuing to supply millions of civilians with their petroleum needs. The Union plant program, part of which will be completed this year, includes a coking plant for high-sulfur crudes, plants to manufacture high-melting-point waxes, catalytic plant operating with unfinished gasolines and distillates as charging stock, plant for production of asphalts and lubricating oils, isopentane plant, and a gas-reversion unit.

The following information summarizes the company's California refinery operations at this time:

Location—	Daily capacity, bbl.—Crude oil	Cracked gasoline
Los Angeles	47,500	*6,000
Oleum	34,000	†5,800
Maltha (Bakersfield)	8,000	....

*Includes 500 bbl. daily of alkymer gasoline.
†Includes 200 bbl. daily of polymer gasoline.

All the refineries manufacture asphalt and the Oleum refinery manufactures lubricating oils and wax. Several licenses cover the company's production of cracked gasolines. Crude runs to stills at the three refineries in 1941 averaged 71,000 bbl. daily.

The present Union company is the result of a merger of three California operating companies in 1890. Since that time the operations of the company which include production, refining, transportation and marketing, have been expanded and now constitute one of the major operations in the western part of United States. The company's net crude-oil production, in 1941 exclusive of royalty and partnership interests, was 42,400 bbl. daily and the net production of eight natural-gasoline plants was 3,200 bbl. daily. The bulk of the company's crude-oil output is in California with smaller production in Wyoming and Texas.

The refineries are supplied through 639 miles of trunk pipe lines and this system last year transported 110,000 bbl. daily with deliveries to plants and terminals in addition to those owned by the Union company. The company operates a fleet of 9 tank ships, 24 barges, and smaller craft. Marketing operations include several western states and export shipments.

The principal offices of the company are in the Union Building, Los Angeles. Reese H. Taylor is president and executive head. Vice presidents are W. L. Stewart, Jr., A. C. Rubel, and A. C. Stewart, who is in charge of sales. Basil Hopper is manager of manufacturing. Superintendents of the plants are: Oleum, R. G. Bray; Wilmington, John Salmond, manager; Maltha, Homer Ambrosier, superintendent.

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THE OIL AND GAS JOURNAL

Pipe-Line Activity

Application for Tinsley Line Is Withdrawn by S. O. of N. J.

Application for authorization from the federal Government for the construction of a crude-oil pipe line from the Tinsley field, Mississippi, to Baton Rouge, La., is reported to have been withdrawn recently by Standard Oil Co. of New Jersey interests. The application of Standard Oil Co. of Ohio interests for a permit to build a line from Tinsley to Memphis, Tenn., was filed before that of the Standard of New Jersey and will not be withdrawn under present conditions.

ICC Approves Rate From Central Texas to Louisiana

As a preparation for moving crude oil from Central Texas to the Mississippi River, Humble Pipe Line Co. has obtained approval from ICC for an emergency pipe-line rate of 10 cents gathering charge and 22 cents trunk-line charge. This applies between the Fambrough station, Stephens County, as well as from the Hawley station, Jones County, Texas, to Anchorage, La., which is located near Baton Rouge. Shipments between these points would move through a hookup including the lines of Humble, Standard of Louisiana and other systems.

Socony-Vacuum Nears Completion Of Kansas Looping Project

The looping program of Socony-Vacuum Oil Co., Inc., White Eagle Division, for increasing capacity of outlet from western Kansas will be completed this week. The project calls for the laying of 23 miles of 10-in. between the point where the White Eagle system joins the Kaw Pipe Line near Chase, and White Eagle's Hollow pump station, Kansas. The work has been contracted by Fredell Construction Co.

Kaw Pipe Line Will Complete Looping Project This Week

An increase in capacity of the Kaw Pipe Line Co.'s system amounting to 25,000 to 30,000 bbl. will result from the completion this week of 34 miles of loops of 8-in., 10-in. and 12-in. pipe to enlarge the outlet from western Kansas in the Chase area. The work was contracted by Fredell Construction Co.

Stanolind Moves Pumping Unit From Texas to Missouri

Stanolind Pipe Line Co. is moving a pumping unit from the Hufsmith station, near Tomball, Tex., to the Freeman station in western Missouri. This unit is driven by a 750-hp. engine and has a capacity of 48,000 bbl. This will contribute to gaining an 8,000-bbl. increase in capacity of the company's system for moving oil northeastward. The full benefit of the addition to facilities at Freeman cannot be obtained until the installation of a supercharger at the Marceline station, Missouri, has been completed; the effect of the changes will not be felt for several weeks.

Construction of 116 miles of loops between Washington, Kans., and Freeman, Mo., which Stanolind has been carrying on in the fall and winter months, has been practically completed. The new loops are now in use. This program consisted of laying 62 miles of 10-in. loops, raising the capacity of the system from 30,000 bbl. to 45,000 bbl. daily, and 54 miles of 12-in., raising the capacity from 45,000 to 55,000 bbl. daily.

Completion of the company's new Laton station, Kansas, has been held up due to delays in receiving equipment. The Laton station is located on the lateral between Bemis and Washington, Kans.

Texas Co. Builds 75-Mile Line to Lawrenceville, Ill.

Although greatly hampered by mud, construction work is progressing on Texas Co.'s new 75-mile 6-in. pipe line from the Salem field to Lawrenceville, Ill. It is expected that the line may be completed within the next 40 days.

The line, which parallels an oil trunk line owned by the company, will carry residue gas from the Texas Co. gasoline plant in the Salem field to the Indian Refining Co. plant at Lawrenceville. The gas will be used as fuel.

Approximate cost of the project is a half million dollars. It is believed that some of the residue gas will be purchased by companies between Salem and Lawrenceville.

Williams Brothers Corp. has contract for 60 miles at Lawrenceville end, and Perry & Walker are constructing 15 miles at the Salem end of the line. The project is now half completed.

Steel Mills Maintain Peak Production

For the third week in succession, steel output of American mills will be at a new peak totaling 1,663,000 tons and operating at 97.9 per cent of capacity, the American Iron and Steel Institute estimates.

This rate was an increase of one-half of 1 per cent over 97.4 in the preceding week, when production amounted to 1,654,500 tons. A month ago operations were at the rate of 96.2 per cent and output 1,634,100 tons and a year ago operations averaged 99.4 per cent and turned out 1,604,200 tons of steel on the basis of capacity at that time.

Texas Pipe Line Operates New Apache-Seminole Line

The 101-mile 8-in. crude-oil line which has been under construction during winter months for Texas Pipe Line Co. between Apache and Seminole, Okla., has been completed and is now in operation. The work was contracted by Black Construction Co.

The line was put in operation for moving oil all the way through to Seminole late last week. Previous to that time part of the line had been used for deliveries to an intermediate point. Shipments are being made at the rate of between 6,000 and 7,000 bbl. per day.

Standard of New Jersey Will Use Tide Water's Pennsylvania Line

Arrangements have been made for Standard Oil Co. of New Jersey to utilize the pipe-line system of Tide Water Pipe Co., Ltd., in Pennsylvania. The principal feature of this system is a trunk line constructed of 6-in. pipe which extends from

Rixford, Pa., to Bayway, N. J. This was formerly part of the 6-in. Tide Water trunk line from Stoy, Ill., to Bayonne, N. J. In 1939 the western end of the system was acquired by Standard Oil Co. of Ohio and has been operated by Sohio Pipe Line Co. to Warren, Ohio. Pipe between Warren, Ohio, and Rixford, Pa., has been taken up.

Sun Leases Loading Rack From Houston Oil Co.

The Sun Oil Co. has completed a lease agreement with Houston Oil Co. for use of a 50-tank car loading rack and storage facilities at Kilgore, so East Texas crude oil will be shipped in tank cars to Sun's refinery at Marcus Hook, Pa.

Standard of Louisiana May Lay Line to Pine Prairie, La.

Standard Oil Co. of Louisiana is reported to be considering laying a 22-mile 5-in. oil line from the Pine Prairie field, Evangeline Parish, Louisiana, to the company's 8-in. carrier located near the town of Bunkie, Avoyelles Parish.

Muskogee-Okmulgee Section of Great Lakes Line Is Removed

The 53½ miles of 4-in. refined-products line of Great Lakes Pipe Line Co., between Muskogee and Okmulgee, Okla., is now in the process of being removed by the Bethlehem Supply Co., who purchased the pipe last September. Taking up the pipe has been contracted by the Sapulpa Tank Co. Already more than 35 miles of pipe have been taken up. Practically all of the pipe recovered from this line has been resold to the Panhandle Eastern Pipe Line Co., Sunray Oil Co. and the Cushing Oil & Refining Co.

Changes in the operation of the southern end of the Great Lakes Pipe Line Co. system call for moving two pumping units from the Okmulgee station and one from Muskogee to the pump station near Barnsdall, Okla. These units are driven by 170-hp. diesel engines. Under the new arrangement, a unit driven by a 75-hp. engine will pump products from the Okmulgee station.

Rock Island Refining Co. Lays Line in Oklahoma

To provide a connecting link to facilitate crude shipments by pipe line from southern Oklahoma northward, Rock Island Refining Co. is laying 4 miles of 4-in pipe in 30-1s-8w, Oklahoma. Through this line crude oil from the West Duncan, Oklahoma, field will go to the Anderson-Prichard system from which it will be delivered at Cement, Okla., to a Rock Island line for tender to the Oklahoma Pipe Line Co. system in the Knox pool, Oklahoma, for shipment north through the Ajax and Illinois systems to Rock Island Refining Corp. refinery at Rock Island, Ind., near Zionsville, Ind.

Government Permits Aerial Surveys for Pipe Lines

Provision has been made for aerial photographic surveys of pipe-line routes through a blanket arrangement which the federal Government has made with organizations which are regularly engaged in contracting this type of work for the oil industry. However, severe restrictions have been placed on photographing from the air in general. The special arrangements made with aerial photography companies make it possible for them to continue to survey for pipe lines without interference with operations which might result from hampering regulation of this type of service.

Pipe-Line Personalities . . . . . F. E. Coyle

F. E. COYLE, superintendent of Tide Water Associated Oil Co.'s southern California pipe-line system, was recently appointed to the California Oil Industry Protection Committee. This body serves as a central committee which coordinates activities of various field and industry groups in the protection of wells, refineries, natural-gasoline plants, pipe lines and other operating facilities in the Los Angeles Basin, San Joaquin Valley and the central district of California.

In this period when petroleum transportation on the Pacific Coast is disrupted as a result of the war, Mr. Coyle finds that solution of some emergency problems is facilitated by his experience at the time when he directed record loading of railroad tank cars during the peak of production in the Huntington Beach field, California.

He has been closely identified with the development and expansion of the oil industry in California for more than 30 years. He entered the industry at the Amalgamated Oil Co.'s Los Angeles, Calif., refinery in 1911. When Amalgamated was consolidated with Associated Oil Co. he remained with the organization. He became an employe of the continuing company when Associated and Tide Water Oil Co. formed Tide Water Associated.

He assisted in construction and installation of the first electric dehydrating units erected in California at La Habra. Later, he was engaged in the construction of Associated Oil Co.'s Santa Maria pipe line, running from the old Santa Maria fields to the marine terminal at Gaviota, Calif., where the company operated a topping plant for a number of years.

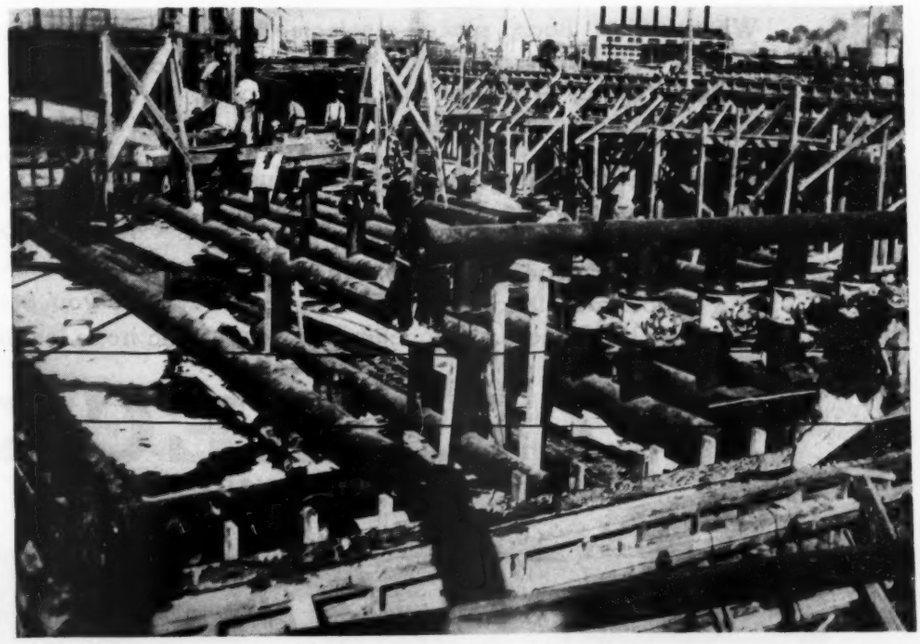
Mr. Coyle also worked on much of the experimental and development work at the Associated's principal refinery at Avon on San Francisco Bay. He returned to southern California in 1923 and became superintendent of the Tide Water Associated's pipe-line system in that part of the state.

Wyoming-Puget Sound Line Is Proposed by R. A. Steinmayer

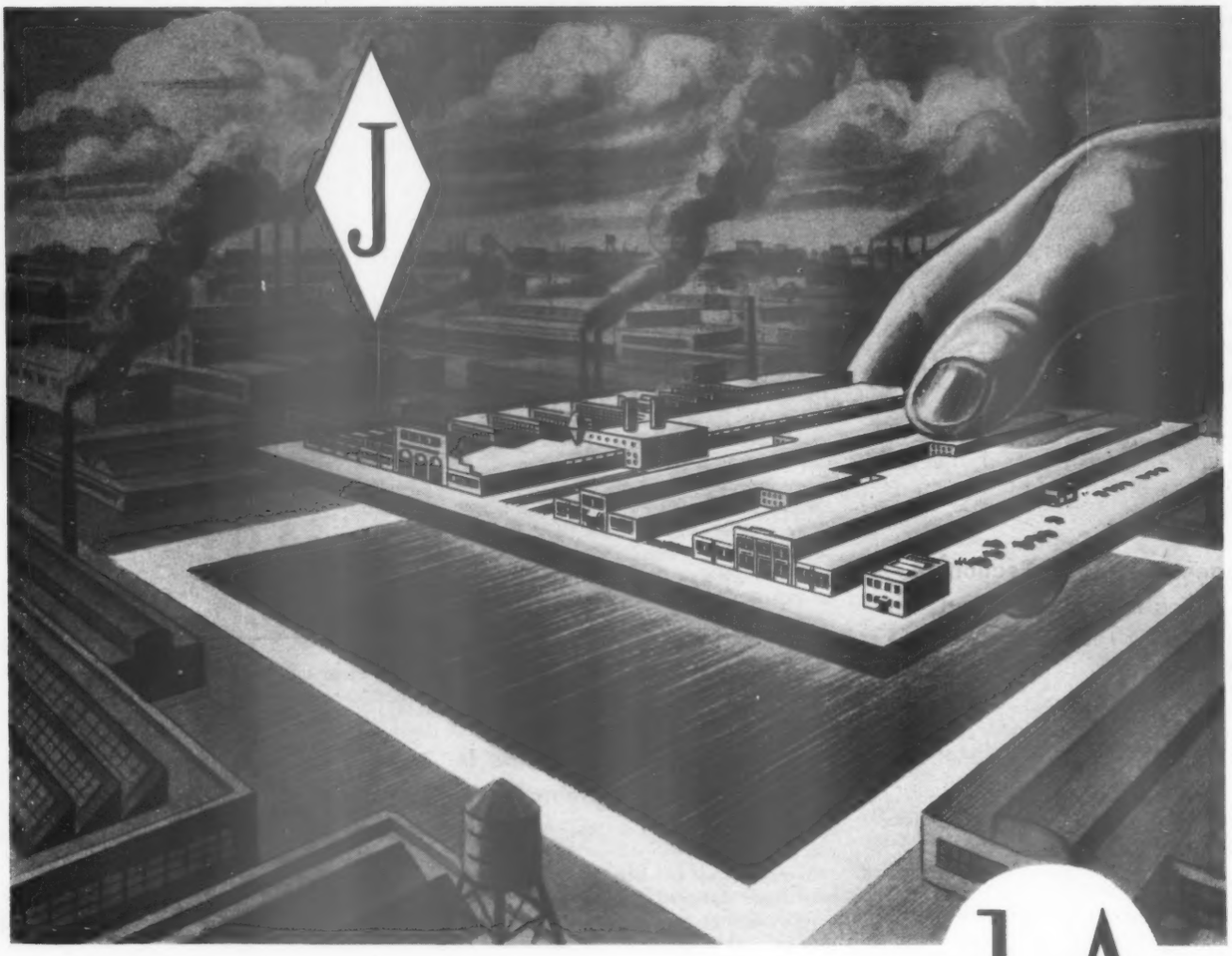
A suggestion has been made by R. A. Steinmayer, associate professor of geology, Tulane University, New Orleans, La., that a pipe line be built from Wyoming to the shore of Puget Sound in the State of Washington. In connection with this he has in mind that a lateral extend down the Pacific Coast to the State of California. This statement appears as a correction of an item on the Personal Paragraphs page of the March 12, 1942, issue in which it appeared that Professor Steinmayer had Washington, D. C., in mind as the location of the terminal instead of the State of Washington. The large black oil reserve in the Big Horn Basin, Wyoming, Professor Steinmeyer believes, could be made a useful factor in the war program.

Atlantic Applies for Pipe Line Permit

The Atlantic Refining Co. of Dallas, Tex., submitted an application to the Vicksburg, Miss., engineer's office of the War Department for a permit to lay a pipe line in the bed of the Catahoula Lake from the C SE NW 27-7-4, La Salle Parish, Louisiana, to the south shore.



Construction of manifolds at river terminal at Baton Rouge, La., where facilities are provided for unloading refined products destined for shipment through the 1,285-mile Plantation Pipe Line Co. system for delivery in southeastern states



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FIELD DEVELOPMENTS...

HIGHLIGHTS FROM THE WEEK'S NEWS—

For the second consecutive week, completions fell below 300 but there was an increase of 21 over the previous week. The increase was almost entirely confined to dry holes, of which there were 104 against 84 during the second week in March. Oil wells were four fewer and there were five more gas wells completed. Although there were almost as many dry holes abandoned last week as during the corresponding week of 1941, they still stand 33 below the 1941 average of 137. This drop of nearly 25 per cent may be considered indicative of the trend of wildcatting activity as by far the majority of dry holes are wildcats. Of course, this week's figures include a number of abandoned tests which were not completed because they did not conform to M-68. Most tests of this kind are temporarily abandoned but many operators are beginning to despair of getting exceptions. Six temporarily abandoned drilling wells are reported from the Texas Panhandle district alone, although these are not reported in the completion table as abandonment is not yet final.

Not only is the record of wildcatting falling behind normal, but the proportion of significant successes is also well below normal. With nearly one-quarter of the year gone, Midway, Arkansas, appears to be the only field of any consequence yet discovered. The three new wells along the Spencer trend in West Texas may develop into a good-sized pool but these important finds are few and far between. It is safe to say that unless this year's record should change abruptly, the amount of new oil discovered will not approach the totals found even during the past 2 years when the discovery rate was below normal.

At this time last year, Lake Creek and Maurbro on the Texas Gulf Coast, Little Creek in northern Louisiana, Dahlgren and Benton in Illinois, Sand Hills extension and Abell (Simpson) in West Texas and Guthrie in Oklahoma had all been found and were recognized as at least fair-sized pools. This year's record is quite poor in comparison.

It will be remembered, however, that the record of the first 3 months of 1941 was much poorer than that of the rest of the year. If wildcatting is stimulated sufficiently, 1942 still has a chance to pick up also.

KANSAS: A new oil pool has been opened in Pawnee County and a new gas field in Barber County. Kraft-Prusa, Hendrickson, Dayton and Smyers have all been extended a short distance (p. 261).

NORTH TEXAS: Deep production, probably from the Mississippi lime, has been opened in Throckmorton County. There are prospects for a new Ellenburger lime pool in Cooke County (p. 252).

ALBERTA: Following successful development of the north extension to Turner Valley, a southwest outpost has been staked (p. 279).

MICHIGAN: With production declining, completions were restricted to one small pumper, three dry holes and five abandoned locations (p. 278).

CALIFORNIA: Completions reached a record low with three oil wells, three dry holes and four recompletions. All of the new wells were in the San Joaquin Valley. Increased need of heavy crude and of gas is spurring wildcatting. A small pumper has opened production in the Shale Hills sector of Kern County (p. 255).

NORTH LOUISIANA: The deepest test in the Lisbon area showed only a small amount of gas and sour condensate in the deep zone and has been plugged back to test higher formations. A new Wilcox sand pool in Concordia Parish will extend the play south and east (p. 266).

MONTANA: Although Kevin-Sunburst operators have arrived at an agreement with regard to the spacing pattern problem, Cut Bank producers are having trouble owing to the existence of different patterns in the two active sectors (p. 278).

TEXAS GULF COAST: Shows are reported in a test west of Esperson, an outpost to North La Ward and a Wilcox test southwest of Goodrich. Needville is extended and a new sand has been opened in the Stowell pool, Jefferson County (p. 257).

SOUTHWEST TEXAS: De Witt County has its second Wilcox sand pool as gas-distillate was found east of Yorktown, and 16 miles northwest of the Thomaston pool. A new gas field has been opened south of McLean in Zapata County (p. 262).

ILLINOIS: A new Aux Vases pool has been opened in southwestern Wayne County and first oil production has been found in Perry County. The pay is in the Cypress at 1,130 ft. Two new McClosky pools are in prospect in Jasper and Richland counties (p. 264).

WEST CENTRAL TEXAS: Although only about 10 per cent of the allowable from the discovery can be marketed, drilling is continuing in the Merkel, Taylor County, area. North Novice has been extended (p. 252).

WYOMING: A flank well at Oregon Basin is making 30 bbl. an hour from the Embar (p. 278).

APPALACHIAN: Drain on Pennsylvania Grade crude stocks may force raising of restrictions on drilling (p. 260).

WEST TEXAS: Two shallow pools are opened along the Spencer trend in Ward County 3 miles north and south of that pool. It is anticipated that the three areas will eventually link (p. 259).

INDIANA: The third new pool during March has been found in Posey County. The McClosky has been found productive near the old Gentryville pool in Warrick County (p. 272).

LOUISIANA GULF COAST: A reported blowout has stopped drilling on a Welsh dome flank test. Wilcox cores are showing oil and gas in an Avoyelles Parish test. A new and deeper sand is producing at Bayou Sale, reported below 12,000 ft. (p. 265).

COMPLETIONS IN ALL FIELDS . . .

(Week Ended March 21, 1942)

	Oil	Gas	Dry	Total	Footage	Tll. comp. to date 1942	Tll. comp. to date 1941
N. Y., Pa., and W. Va.	42	14	4	60	133,402	917	927
Ohio	0	5	9	14	27,769	232	303
Indiana	2	0	5	7	13,205	98	89
Kentucky	1	2	1	4	10,548	80	112
Illinois	9	0	10	19	50,659	454	585
Michigan	1	0	3	4	11,989	161	184
Kansas	7	0	5	12	36,762	366	355
Nebraska	2	0	1	3	5,330	12	17
Missouri, Iowa	0	0	1	1	325	4	2
Oklahoma	5	1	16	22	56,896	358	287
Texas:							
North Central Texas	8	1	7	16	45,081	379	545
West Texas	27	1	4	32	140,182	463	403
Texas Panhandle	5	1	1	7	22,045	148	107
East Texas	10	0	2	12	54,335	123	235
Texas Gulf Coast	8	1	3	12	79,111	222	221
Southwest Texas	13	0	18	31	133,367	332	333
Total Texas	71	4	35	110	474,121	1,667	1,844
North Louisiana	2	0	6	8	35,087	149	129
Louisiana Gulf Coast	7	0	1	8	65,507	156	176
Total Louisiana	9	0	7	16	100,594	305	305
Arkansas	1	0	0	1	6,439	35	36
Mississippi and Southeast	0	0	0	0	0	23	37
Montana	1	0	1	2	5,931	36	54
Wyoming	1	0	1	2	5,473	22	30
Colorado	0	0	0	0	0	4	6
New Mexico	5	0	2	7	27,004	64	68
California	3	0	3	6	28,031	220	231
Total United States	160	26	104	290	994,478	5,058	5,472
Total previous week	164	21	84	269			
Week ended Mar. 22, 1941	270	47	109	426			

Arkansas Smackover Lime Pools Have Large Sour-Gas Reserves

THE Smackover lime fields of southern Arkansas have been responsible for the development of many industries in the region and, from an oil standpoint, have paved the way for much exploration. Development started with the discovery of production in the Reynolds lime member at Schuler in 1937. This was followed closely by the opening of the Magnolia, Village, Buckner, Atlanta, Dorcheat, McKamie and Macedonia fields of which the three last named are mainly gas-distillate fields.

All of these fields are in Union, Columbia and Lafayette counties and lie south of a major fault system which extends southwest to Rodessa. North and west of this fault, the Smackover lime was believed to be tight and barren but in January 1942 a new field was found in northern Lafayette County which yielded good production from the Smackover lime. This field, Midway, differs from the others in that it produces a sweet oil and has a very low gas-oil ratio.

Structural Features

All of the fields lie on elongated anticlines which have steep dips on the flanks. The structures all run east and west, except Midway which has a northwest-southeast trend. There is a tendency to an echelon arrangement as can be seen from the accompanying map of the Dorcheat-Macedonia area.

Dorcheat, Macedonia and McKamie were all in process of development when M-68 came into existence. As they were considered gas fields, with the possible exception of Dorcheat, development immediately ceased since Dorcheat was being drilled on 40-acre spacing, Macedonia on 80-acre spacing and McKamie on 160-acre spacing. Classifying the fields as gas fields would place them on 640-acre spacing. It was suggested that a recycling operation might be set up by means of which pressure could be maintained and the distillate removed, which would convert the fields into oil fields and permit a resumption of drilling on a smaller spacing pattern. At a recent hearing before the Arkansas Oil and Gas Commission, it was pointed out by operators and independent engineers alike that this program would be too costly as the sulfur would first have to be removed from the gas which involves reduction to 600-lb. pressure and then it would have to be compressed again to 4,000 lb. for injection into the sand.

In the meantime contracts had been made to erect desulfurizing plants which would produce nearly 200 tons of sulfur a day from the three fields and supply clean gas for the great industrial demand which has developed in the Little Rock area in connection with war industries and the aluminum reduction plants intended to utilize Arkansas ores.

McKamie

The McKamie field occupies an estimated 3,000 acres and now has 15 producing wells. Nine of these wells were drilled on regular 160-acre spacing; the remainder were not but have had irregular 60-acre rectangles allocated to them. Although there is some liquid oil at the bottom of the pay, the principal production is distillate and each well is now permitted to produce 200 bbl daily. The gas-oil ratio is about 8,000 cu. ft. per bbl. The gas has one of the highest contents of H_2S known, running about 4,000 grains of sulfur per thousand cu. ft. To date the field has produced over 1,100,000 bbl. of 58° distillate.

The pressure at the time of discovery was 4,365 lb. and this has since dropped to 4,224 lb. This small decline in pressure, together with the water encroachment in the only abandoned producer in

(Continued on Page 272)

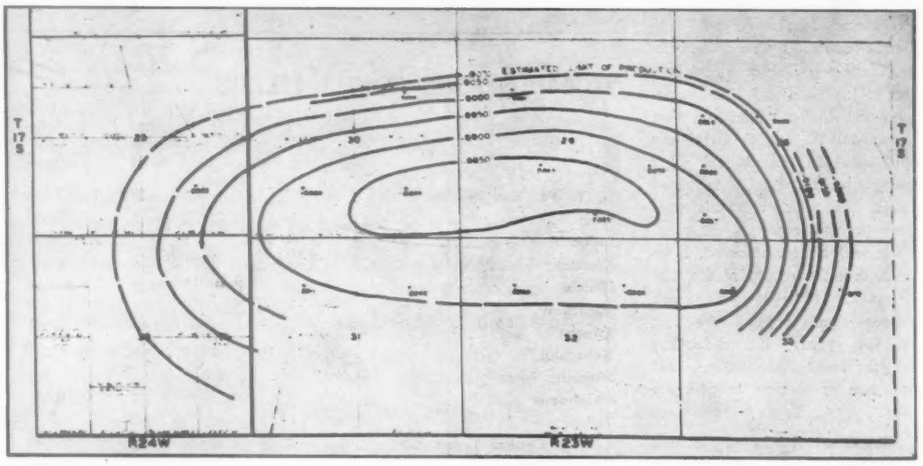

Fig. 1—Map of McKamie field (right), Township 17s, range 23 and 24w, Lafayette County, Arkansas, showing present development. Contours on top of main porosity in Smackover lime

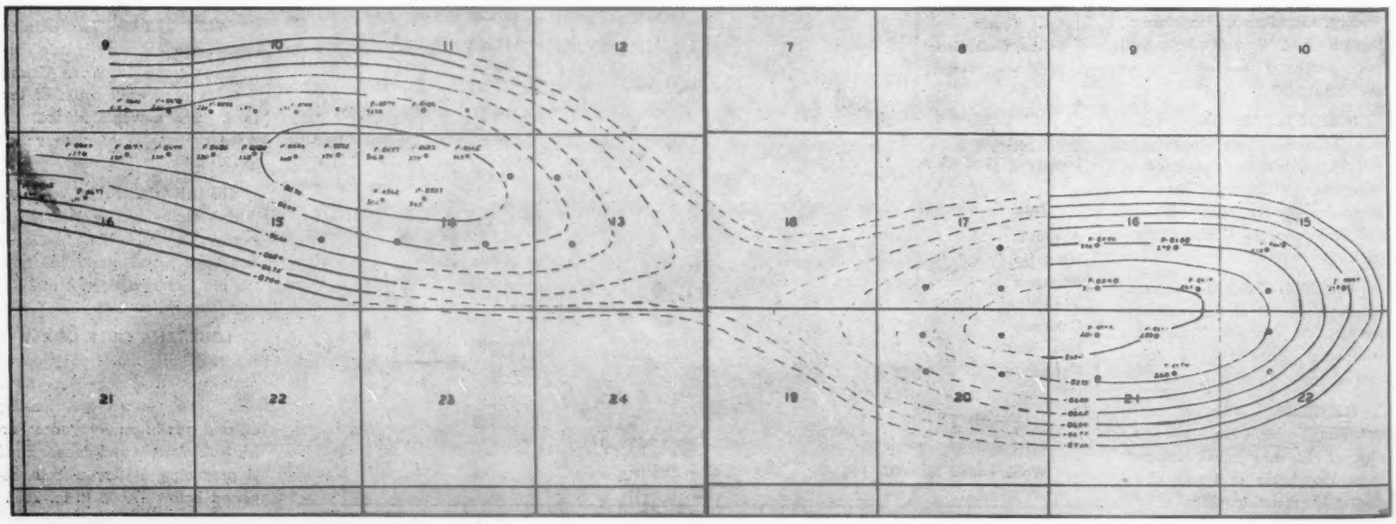

Fig. 2 (below)—Dorcheat and Macedonia fields, Township 18s, Range 22 and 21w, Columbia County, Arkansas, showing present and proposed development. Contours on top of Reynolds lime

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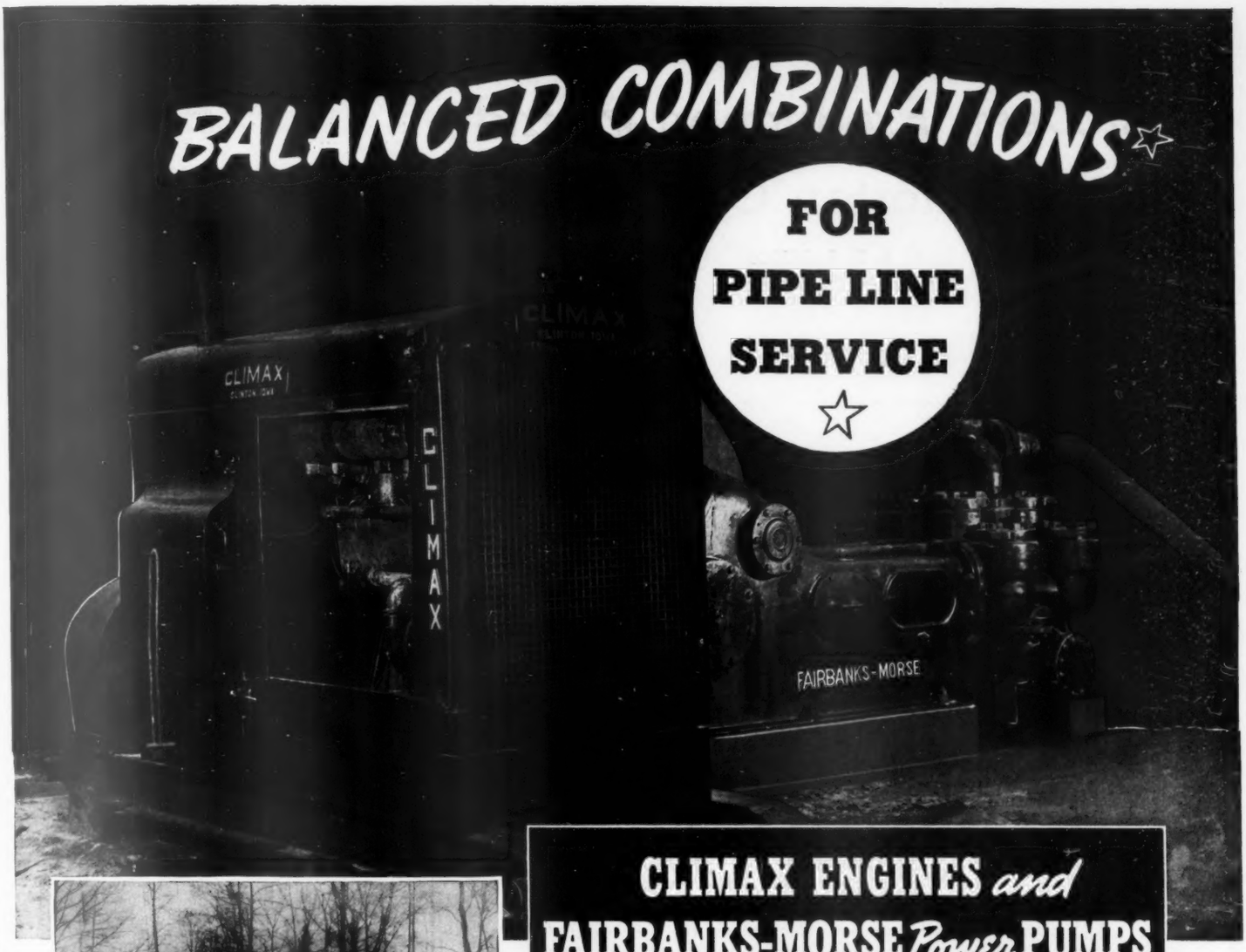

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First Deep Production Found In Throckmorton County

By D. H. STORMONT

FORT WORTH, Tex.—Deep production was opened in southwestern Throckmorton County last week at Groover & Rose and Jones & Stasney 2 C. T. Brockman, Section 94, Comanche Indian Reserve Survey, 20 miles southwest from the town of Throckmorton. It was the first pay in that part of the county from below 1,000 ft., and was probably from Mississippi lime.

There was some opinion that the production was coming from Marble Falls (basal Pennsylvanian), but there was no doubt that the well marked a major regional extension of the Mississippi lime play which has centered on Young County directly to the east.

At mid-week the well was showing for a producer. It had been bottomed at 4,735 ft. in lime, and had 5½-in. casing set at 4,707 ft. Operators swabbed to the bottom after drilling plug and then let the hole stand for 14 hours. During that time it filled 500 ft. with oil.

The well was then washed with 400 gal. of acid from 4,708-35 ft., after which it kicked off. After being allowed to flow for an hour, it was shut in for further tests. Estimates placed the flow at from 35 to 40 bbl. an hour through tubing with no water showing. Gravity was 45.

The well was the second attempt to find production on the Brockman acreage. The 1 Brockman, drilled ¼ mile to the west of No. 2, had a show of oil but was plugged in June, 1941, when it showed too much water. The No. 2 well, however, ran 15 ft. high to the first test and also had indications of possible shallow production in Fry sand at 700 ft. At week's end, operators were building storage for volume and pressure gages.

Six miles to the northeast, Humble Oil & Refining Co. 1 Cain, Section 1,632, T.E.&L. Survey, was squeezing off perforations at 4,400 ft. after a production test at that depth had failed. Casing will be reperforated for a new try. Humble, which has opened one Caddo lime pool in Throckmorton County, also supported the Brockman test and holds nearby acreage.

Wildcat Testing in Cook County

Lou Stogner of Fort Worth and R. H. Dearing & Sons of Dallas appeared to have struck a new Ellenburger lime pool in southwest Cooke County, 2 miles north of Rosston. The well was 1 Ray Berry, T. B. Hardwick Survey, which cored Ellenburger lime at 5,914-24 ft. and then stopped drilling in order to test.

A 1-hour drill-stem test was run at 5,819-24 ft., but the tool became stuck and operators had to circulate to free it, making the test unsuccessful. At week's end the operators said they planned to make about 50 ft. more of hole and then set casing on bottom to be perforated for further tests.

From an elevation of 954 ft., the well topped the detrital zone at 5,810 ft. and then drilled dolomite showing oil at 5,828-82 ft. A core at 5,832-46 ft. returned full recovery of coarse crystalline detrital dolomite with streaks of shale, showing oil and fair porosity. A previous drill-stem test at 5,846-58 ft. in lime recovered 60 ft. of oil-cut mud. Top of the hard Ellenburger dolomite was called at 5,920 ft.

The well is located on the west flank of a schist high extending southwest into Denton County. It is ¾ mile northeast of a 3,195-ft. dry hole drilled several years ago by Gulf Oil Corp.

Other Tests

Hill & Hill completed a new well for the new Hoefle pool in Jack County (see completions) and Hanlon-Buchanan 1 Hoefle, nearby, was testing at 4,885 ft. . . . Also in Jack County, Wilcox Oil & Gas were drilling below 6,180 ft. in dry dolomite at 1 Bloodworth, William Donald Survey. Ellenburger lime was topped at 6,070 ft. . . . Continental Oil Co. 1 Ferguson, Archer County wildcat southwest of Holliday, made only a slight show through perforations at 4,468-82 ft. and was to reperforate higher. . . . In Montague County, Sinclair Prairie 1 Jones, Singletary Survey, 1 mile northeast of Forestburg, was bottomed at 7,372 ft. after testing oil-cut mud at 7,336 ft.

NORTH CENTRAL TEXAS COMPLETIONS

Wildcats

Clay County: Gulf 6 Worsham estate, 2,304 ft. from NL and 1,006.5 ft. from EL Sec. 37, H.&T.C. Sur., Blk. 4, flowed 656 bbl. in 8 hr. through ¾-in. choke on 2-in. tubing, acid, gravity 46.2, gas-oil

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ratio 1,033:1, C.P. 1,200 to 760 lb., T.P. 1,000 to 390 lb., T.D. 5,557 ft., *extends Ringgold production 1 mi. northwest.*

Fields

Davenport, Montague County: Lesh & McCall 1 W. A. Reed et al, 150 ft. from NL and 200 ft. from EL of S 113 acres of farm in T. J. Robinson Sur., 268 bbl., 6⅝-in. casing 2,467 ft., perf. 2,320-30 ft. in sand, T.D. 2,610 ft.

Hoefle, Jack County: Hill & Hill 1 Mary Hoefle, 466.5 ft. from N and EL of 30.53-acre lease in J. Barrett Sur., A-48, W offset to discovery well, flowed 119.34 bbl. in 3 hr. through ½-in. tubing choke, potential 954 bbl., top Caddo lime 4,899 ft., show oil 4,918-35 ft., acid, T.D. 4,935 ft.

Sewell, Young County: Lohan Drilling 1 G. O. Hazleton, 467 ft. from N and EL of J. Harmon Sur., A-1607, potential 12 bbl. oil and 2,500,000 cu. ft. gas, pay 3,915-38 ft., acid, T.D. 4,310 ft.

Swastika, Young County: C. T. Robertson 1 J. R. Suite, 330 ft. from N and WL of Sec. 1591, T.E.&L. Sur., dry, T.D. 1,390 ft.

Thornberry, Clay County: Akin, Dimock & Costley 1 Joe P. Patrick-A, 1,100 ft. from NL and 900 ft. from WL of Sec. 82, Byers Brothers subd., pumped 50 bbl. oil and 5 bbl. water, pay 1,120-28 ft., T.D. 1,128 ft.

Webb et al 1 C. T. Taylor estate, 500 ft. from NEL and 2,650 ft. from SL of Blk. 56, Bacon subd., dry, T.D. 1,870 ft.

Market Problem Fails to Halt Development in Merkel Sector

In spite of difficulties in finding a market for oil from the discovery well, offsets to Snoddy Brothers 1 D. L. Tipton, 2½ miles west of Merkel in Taylor County, were drilling ahead last week. Jennings & Griffin 1 L. S. Tipton, 660 ft. east, 330 ft. from the south and west lines of the east 200 acres of the north 400 acres of Section 20, Block 18, T.&P. Survey, was drilling below 1,000 ft.

T. J. Waggoner et al 1 J. H. Doscher, southeast offset, 330 ft. from the north and west lines of the east 121 acres of the south 240 acres of the same section was below 450 ft., and W. H. Hammon 1 Doscher-Neblett, 330 ft. from the north and east lines of the west 120 acres of the south 241 acres of Section 20, was resetting surface casing after the first string collapsed. Rig was skidded about 20 ft. for the new hole.

Meantime, William L. Snoddy, partner in the discovery well, reported that he had found a market for only about 10 per cent of the well's 120 bbl. a day allowable. Both Humble and Magnolia pipe lines are within a few miles, but purchasers have been reducing their runs from the entire area in recent weeks.

Novice Pool Extended

In Coleman County, the Robert W. McKissick 1 Morris, extension to the North Novice pool in the W. D. Wyatt Survey 137, was put on production with an official gage of 189 bbl. Production was from 3,542-62 ft.

Jones County Active

Jones County continued to be the most active area of West Central Texas, both as to wildcatting and field development. Among new tests started were: Danciger Oil & Refining Co., William L. Snoddy and Carl S. Shouts et al 1 W. L. Brigham, Section 38, Deaf and Dumb Asylum Land Survey, a 3,800-ft. test 660 ft. from the north and west lines of the NW¼ of the section, 5 miles northeast of Anson; and H. W. Lee 1 A. D. Roberts, Section 2, Block 16, T.—P. Survey, between the Wimberly and Hawley pools.

WEST CENTRAL TEXAS COMPLETIONS

Wildcats

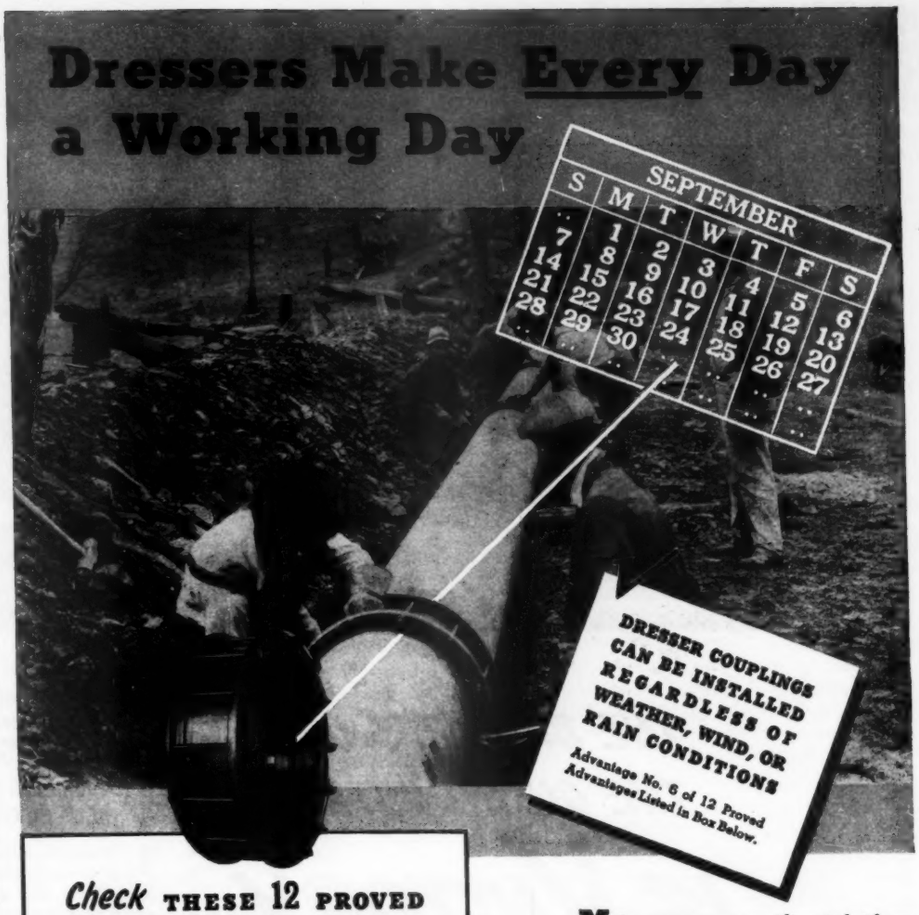
Comanche County: C. D. Lane 1 C. M. Adams, J. C. D. Scott Sur., A-860, dry, water sand 1,460 ft., T.D. 1,500 ft.

L. B. Tannehill 1 Terrill heirs, Swanson Yarberry Sur., A-1035, dry, water sand 1,110 ft., T.D. 1,142 ft.

Eastland County: Minerals & Metals, Inc., et al 1 Freyschlag & Graves, Thomas Foster Sur. 22, A-130, flowed 5 bbl. oil and 310,000 cu. ft. gas, gas sand 3,044-65 ft., lime 3,160-3,205 ft., shot 3,040-60 ft. and 3,160-3,203 ft., T.D. 3,420 ft. in shale, *discovery.*

McCulloch County: Homer Eastwood 1 W. C. Johnson, A. Nevendorf Sur. 1355, dry, Ellenburger lime 2,044-54 ft., T.D. 2,336 ft.

(Continued on Page 266)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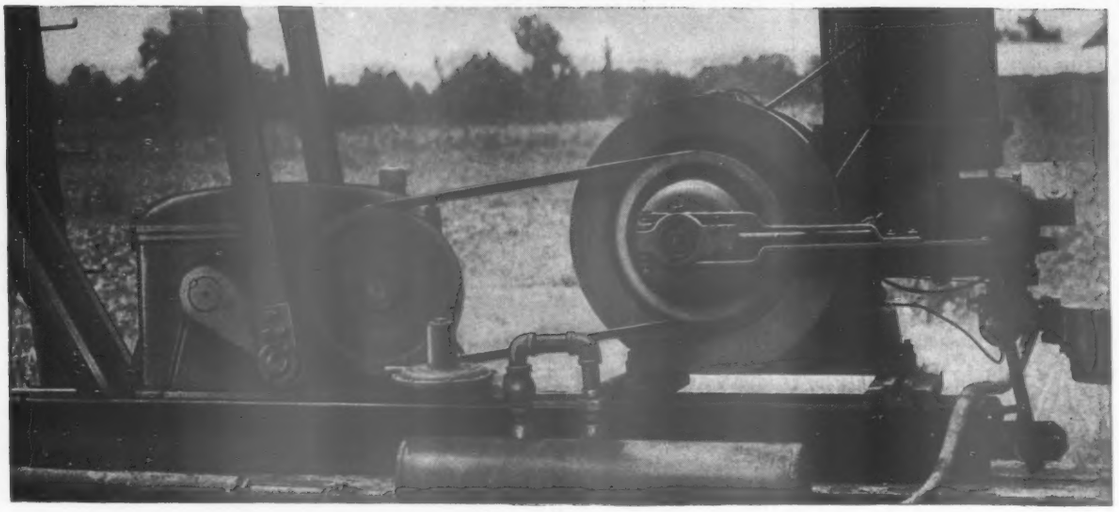

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Prospecting for Needed Heavy Crude Slowed by Low Price

By L. P. STOCKMAN

LOS ANGELES, Calif.—The petroleum coordinator, when fixing California's allowable for the month of April, deviated from past procedure as the new allotment of 659,800 bbl. per day includes all crude oil, condensate, and natural gasoline. By combining these commodities, the production committee for District 5 will be able to more nearly approach its objective each month. On the basis of January 1942 production, crude-oil allotment for April will approximate 625,000 bbl. daily. During January, natural-gasoline production averaged 36,091 bbl. and liquefied-gas production totaled 6,232 bbl. per day but this has varied somewhat since that time. Of paramount importance, however, is the necessity of immediately increasing production of heavy crude oil in order to meet the demand for fuel oil. The fuel-oil situation has not reached the critical stage but will approach that point before the close of the current year unless production is greatly stimulated. It is questionable how much production of heavy crude oil can be boosted but it is imperative that every attempt be made to get out every barrel possible from currently producing fields.

The rapidly rising prices of necessary materials and supplies have greatly increased production and lifting costs and has practically wiped out the thin margin that may have existed in the most efficiently operated properties. With crude-oil prices pegged and production costs rising, the producer is in the center of a vicious circle with little hope of relief except through the price administrator who could not be expected to be familiar with all phases of production costs. In flush fields where lifting costs are more favorable, operators have a sufficient margin in which to operate. Recent developments indicate the price administrator appears to have recognized the situation confronting heavy crude-oil producers and may be able to offer some relief. The survey recently made by Commander Osgood, a disinterested party, will undoubtedly prove of great value in outlining the type and amount of production equipment needed, cost of rejuvenating wells producing heavy crude oil, and the probable future production from existing fields. Until action is taken on this report, however, few wells can be returned to production as most San Joaquin Valley strippers were reduced to skeleton form a number of years ago as there did not at that time appear much chance of resuming production of heavy crude oil in the face of numerous discoveries of light refining crude.

Wildcatting Increasing In San Joaquin Valley

The consistent reduction in drilling operations, due to the scarcity of fields permitting development on the basis of one well to 40 acres, has stimulated exploration work and recent developments indicate the probability that wildcat drilling will greatly increase later in the year. As has been expected, the scope of exploratory work is greatly increasing and acreage has been taken in some cases in areas that have heretofore not been regarded with too much favor by geologists. Regulation of natural-gas production, incident to the regulation of crude-oil production, is expected to stimulate the search for natural-gas accumulations and areas that have heretofore shown production possibilities will again be tested out. This resulted in Texas Co. entering the Bowerbank area in Kern County where the company appears to have found a possible commercial accumulation of dry natural gas in two deep wells that were plugged back and redrilled to 4,250 ft. These two wells proved good for about 10,000,000 cu. ft. of gas daily and the company already has two additional wells headed down to the Bowerbank gas zone. The two new wells under way are expected to prove the extent and value of the discovery at Bowerbank which, on the basis of initial production of the first two wells, is expected to be of commercial importance. Gas fields, with the possible exception of Rio Vista which is the best gas field in the state, have never been able to go on steady production due to the preponderance of natural gas from oil fields and the lack of flexibility in meeting peak loads. Obviously a new commercial gas field in the lower San Joaquin Valley would permit a greater amount of natural gas to go south into southern California.

Wildcat Located West of Panoche Discovery

Of great interest to California operators is the location of a new wildcat in the Panoche district of Fresno County by Superior Oil Co. and Jergins Oil Co. This new wildcat will be located in 34-14s-13e, on the Chency ranch about 1 mile west of a discovery well drilled more than a year ago by Jergins Oil Co. which was a small producer of high-gravity oil. Production was developed in the Cretaceous and consequently the new well now being started will have the Cretaceous as its objective. The Cretaceous has never produced large quantities of crude oil in California and for this reason the outcome of drilling by Superior and Jergins will be watched with considerable interest. If these operators succeed in developing large production they will open up the great central part of the San Joaquin Valley for development and prospecting. The Cretaceous extends southward from the north central part of the state down into Fresno County and the finding of flush production in rocks of this age would greatly stimulate wildcat exploration.

The Cretaceous has yielded a number of commercial gas fields in the central part of the state around the San Francisco Bay region and while these gas wells usually produce a drip of condensate none of the gas fields has produced any commercial amount of crude oil. The value of gas fields is further evidenced this week by the staking of location for a new well to be drilled in the Petaluma area where Trico Oil & Gas Co. developed a substantial flow of dry gas at a shallow depth last year. This new well will be drilled by Standard Oil Co. in 14-5n-7w, on a community lease acquired late in 1941. Drilling costs are and the ultimate production could be much lower than other gas fields and still represent a good investment. Only one well has been drilled to date in the Petaluma district. This was in 30-5n-6w, and finished at 1,500 ft. Standard's new test is located northwest of the discovery well and will consequently greatly extend the productive limits of the Petaluma gas field if it is completed as a commercial well. The restriction against drilling more than one gas well to each 640 acres may retard development.

Mount Poso Outpost Finds Vedder Oil

Union Oil Co. is working on a good looking wildcat west of the northern tip of the Mount Poso field and may prove up the existence of a new productive area in that region. This is a search for shallow production of heavy crude oil with the Vedder zone of Miocene age as the objective. The company drilled and abandoned one well in this region last week at 2,862 ft. but immediately started a second. It is the latter that has found some oil in the Vedder but at present it is not known whether it is thick enough to produce commercially. It has just been touched and nothing will be known until a core or two has been pulled. Many wells in the eastern rim of the San Joaquin Valley encounter the Vedder only to find that it carries water or is too thin to produce commercially. It would prove to be of great importance if the company should develop commercial production in view of the large demand for heavy crude oil and it would prove advantageous to the company as it would be allowed to proceed with development work in order to develop added quantities of heavy oil. Shell Oil Co., Inc., has been attempting to prove up the limits of a new heavy-oil field in the Dyer region which is a fault trap and will probably have to drill another well as 3 Smith-Cairns in 11-26s-27e has been abandoned as a duster at 2,439 ft.

Shale Hills Section Yields Small Pumper

Continental Oil Co. apparently has the makings of a small pumping well on the Mabury lease in 25-26s-18e, in the Shale Hills section of Kern County as some 13-gravity oil has been bailed from its first well with bottom at 950 ft. This well was carried down to 1,992 ft. but was plugged back to the effective depth. A string of 8⅝-in. casing has been cemented at 835 ft. and plans are under way to make a pumping test. Top of the Kreyenhagen was cored in this wildcat at 943 ft. and the Point of Rocks sand was logged at 1,869 ft. The company is getting ready to spud in a second well on the adjoining section, 24-26s-18e. The Shale Hills area has been turned down on numerous occasions as unproductive.

SAN JOAQUIN VALLEY COMPLETIONS

Dyer Creek, Kern County: Dyer Creek Oil Co. 1 Church, 2-26s-27e, dry, T.D. 2,612 ft., Pyramid Hills sand 2,528 ft., grit zone 2,586 ft., barren Vedder zone 2,588 ft.

Shell Oil Co., Inc., 3 Smith-Cairns, 11-26s-27e, dry, T.D. 2,439 ft., 8⅝-in. casing cemented 2,307 ft., oily water rose 17 ft. in 1 hr. from 2,312 ft., pulled liner and deepened to 2,439 ft., bottomed in gray sand and siltstone.

Mount Poso, Kern County: Signal Petroleum Co., 1 Louden, 32-26s-28e, dry, T.D. 1,873 ft., top Vedder zone of Miocene age 1,796 ft.

Union Oil Co. 31 S. & M., 4-27s-28e, pumped 50 bbl., net, 15.8-gravity, 90 per cent cut, T.D. 1,816 ft., perf. 1,733-1,815 ft., completed in Vedder zone of Miocene age.

Paloma, Kern County: Ohio Oil Co. 10-A Kern County Land, 4-32s-26e, flowed 240 bbl., 38.1-gravity, 0.5 per cent cut, 875,000 cu. ft. gas, 12/64-in. bean, T.D. 10,241 ft., 100-mesh perf. 10,038-10,239 ft., N point 9,921 ft., completed in Paloma zone of Miocene age 10,005-10,241 ft.

Tupman, Kern County: Richfield Oil Corp. 61-31-B Kern County Land, 31-30s-25e, flowed 831 bbl., 34.1-gravity, 0.3 per cent cut, 850,000 cu. ft. gas, two 96/64-in. beans, pressures 100/800 lb., T.D. 9,050 ft., perf. 8,424-8,578 ft., 8,617-97 ft., 8,736-8,578 ft., 8,911-9,044 ft., N point 8,087 ft., completed in Stevens oil zone of Miocene age.

Second Well Started In Buena Park Area

Texas Co. is starting a new well in the Buena Park field which it discovered a few weeks ago following an extensive series of production tests between 8,980-9,660 ft. The discovery well, 1 Spencer in 1-4s-11w, is at present flowing 100 bbl. of

21.6-gravity oil cutting 1 per cent daily through a 32/64-in. bean from an effective depth of 8,980 ft. The second well of Texas Co. should give more light on the structure and productive zone and for this reason the outcome of drilling will be watched with interest. Water trouble bothered the discovery well for several weeks but this was finally conquered and the well is now producing relatively clean oil. West of the West Coyote field of Orange County, Texas Co. is preparing to begin actual drilling operations on 2-A McNally in 15-3s-11w. The McNally ranch, which is located in the La Mirada district, has considerable merit and if the West Coyote anticline comes up again it should be in the La Mirada area which is located at a strategic interval.

LOS ANGELES BASIN COMPLETIONS

Richfield, Orange County: Texas Co. 2 Yarnell, 33-3s-13w, pumped 65 bbl., 15.8-gravity, 40 per cent cut, T.D. 4,653 ft., P.B. 3,788 ft., perf. 3,125-3,325 ft., recompleted after being P.B. and gun perforated.

Wilmington, Los Angeles County: Kirk and associates 1 Community, 32-4s-13w, pumped 90 bbl., 16.1-gravity, 20 per cent cut, T.D. 3,714 ft., gravel-packed perf. 3,015-74 ft., 3,459-3,713 ft., set whipstock 3,040 ft., redrilled and gravel packed 5½-in. liner, recompleted in Ranger zone.

Macmillan Petroleum Corp. 5 Hayes, 32-4s-13w, pumped 100 bbl., 14.6-gravity, 5 per cent cut, T.D. 3,547 ft., perf. 2,630-2,800 ft., 2,848-3,043 ft., 3,208-3,535 ft., recompleted after redrilled from 2,459 ft. to Ranger zone.

Rush, Nelson & Graham 2 Ashbridge, 32-4s-13w, pumped 85 bbl., 15.2-gravity, 12 per cent cut, T.D. 3,674 ft., perf. 2,743-90 ft., 2,900-3,255 ft., 3,410-3,605 ft., 3,644-73 ft., recompleted in Ranger zone after hole redrilled from 2,743 ft.

Southeast Outpost at Newhall-Potrero Holds Production

The southeasterly extension of the Newhall-Potrero field, Willis et al 1 Ferguson in 36-4n-17w, is holding up in good shape as present production through a 14/64-in. bean is 235 bbl. of very clean 34.2-gravity oil and 195,000 cu. ft. of gas daily. This well, completed a week or so ago, was drilled to 7,519 ft. but was plugged back to 7,020 ft. because of a gray water sand in the bottom of the hole in the third Modelo zone of Miocene age. The well is at present producing from both the first and second Modelo zones as the hole was finished with 183 ft. of 4¾-in. liner landed on bottom and perforated at 6,874-7,014 ft. A string of 7-in. casing was previously landed and cemented at 6,857 ft. When the well only showed small production from the second Modelo zone the operator went back into the hole and perforated opposite the first Modelo zone of Miocene age to get sufficient gas to stimulate production. The gas is coming through perforations at 6,700-30 ft. and 6,770-6,835 ft. No plans have been made for the future as the well will be watched for another 60 days to see if production and pressures hold up before undertaking any additional drilling. Barnsdall Oil Co., which started a new well south of the Newhall-Potrero fault, is making good headway and within another few weeks will be in a position to determine if production can be secured south of the fault which hitherto has been believed to be the outer limits of production. There is still a possibility that Willis et al 1 Ferguson may be on a separate structure as this outpost is 1 mile southeast of nearest production of Barnsdall Oil Co. which is north of the Newhall-Potrero fault. This fault is between the Willis well and present production of Barnsdall but if it does not influence the accumulation Barnsdall's future production will be greatly increased. The depth of the Willis outpost tends to indicate that the south block of the Newhall-Potrero structure may be lifted up and the north block dropped down. At any rate Barnsdall 31 Rancho San Francisco now drilling south of the cross fault should reach the 7,000-ft. level within a few weeks.

Cat Canyon Outpost To Be Deepened

A. E. Bell is apparently not convinced that his 1 Gilmore in the north end of the Cat Canyon field of Santa Barbara County is out of the running as he has started deepening operations with present bottom at 6,450 ft. in chert. This well looked very good several times during the course of drilling but failed to come up to expectations when given the chance to produce. It is thought that some more hole may change the picture as the development of Miocene production at this point would greatly extend the field and prove up considerable acreage for Bell. In the Gato Ridge field of Santa Barbara County, Republic Petroleum Corp. has passed the 4,100-ft. level in 1 Price in 16-8n-32w, but has not yet found the pay. The next 2 or 3 weeks should determine the status of this outpost which is located rather far downdip. Drilling operations in the Santa Maria Valley field have been reduced to the point where there are only two strings of tools in operation at present and there does not appear much chance of any great increase in work as long as the 40-acre spacing plan is in effect. In the Ventura Avenue field of Ventura County, Lloyd Corp. is cleaning out 1 Lloyd, now bottomed at 7,487 ft., preparatory to deepening it to the lower Lloyd zone that has been found highly productive in the east end of the field. On the Temescal anticline, Pacific Western Oil Co. is nearing the 2,000-ft. level in 11 Temescal in 4-4n-18w, but still has some distance to go before reaching its objective.

A successful search for heavy crude might go far in removing California from the drilling doldrums in which it now finds itself. When the second largest oil-producing state sees only six finished wells, of which one-half are dry, it indicates that the oil industry is sorely disorganized.

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Outpost West of Esperson Dome Due for Test

By F. L. SINGLETON

HOUSTON, Tex.—Interest in the Texas Gulf Coast district was centered on the Crosby area, Harris County where preparations were being made to test Atlantic 1 Cohn located in the M. Duncan Survey, just west of the Esperson dome in Liberty County. With the hole bottomed at 9,505 ft., 5-in. liner was cemented just below 9,100 ft., and the well is scheduled to test the interval from 8,800-1[illegible] ft., where sidewall cores are reported to have recovered sand with an odor of oil and gas. The well has attracted much attention for the past few weeks in view of attempted blowouts in the Yegua formation from which production is being developed on the east and southeast flanks of the Esperson dome.

North La Ward Outpost Recovers Oil Show

Operators interested in the North LaWard field, Jackson County, were watching the progress of Magnolia 15 Gordon, an outpost test located in the I.&G.N. Survey, Section 3. Sandy shale and sand with an oil show was logged in the normal pay at 5,215-25 ft., and the well is drilling in shale below 7,530 ft., possibly in the Yegua, although no geological markers were available. West of the field, and located in the Texana area, another dry hole was marked up for the structure with the abandonment of Gulf 1 Simons, F. F. Wells Survey. The well was drilled to a total depth of 7,801 ft., and was tested through perforated casing at 7,614-21 ft., 7,155-60 ft. and at 5,060-70 ft., but all showed salt water. The Discorbis was topped at 4,594-4,624 ft., Eponides at 4,744-74 ft., Heterostegina at 4,894-4,924 ft. and the round Marginulina at 4,990-5,000 ft. No Vicksburg was logged to a total depth of 7,000 ft.

Southwest of the Goodrich field, Sinclair Prairie 1 G. H. Jones, A. Viescar Survey was bottomed at 10,115 ft., and 5½-in. casing was cemented at 7,230 ft., preparatory to testing in the upper Wilcox. Details as to where the formation was topped and what shows were logged were not available. All production developed in the area thus far has been from the Cockfield sand, and production has been small. Approximately 5½ miles east of the Lake Creek field, Montgomery County, Superior Oil Co. of California is building derrick for 1 Mahan et al, a projected 12,000-ft. Wilcox test located in the Thomas Survey. The prospect is known as the Deering prospect, and is closely related with the Lake Creek field.

W. L. Goldston 1 Lehman, an extension well to the Needville field, Fort Bend County, was flowing at the rate of 5 bbl. of fluid per hour, through a ¼-in. choke while testing through perforated casing opposite the Frio sand at 5,180-86 ft. Ninety-eight per cent of the fluid was oil and 2 per cent was salt water. Tubing pressure was 600 lb., and shut-in casing pressure 1,200 lb.

New Pay Zone Opened In Stowell Field

Distillate production from a new sand was opened in the Stowell field, Jefferson Parish as Glenn McCarthy 1 E. A. Englin, an offset to the discovery well, flowed 175 bbl. of distillate per day through a ¼-in. choke from perforated casing at 8,420-23 ft. Tubing pressure was 2,975 lb., and casing pressure 3,100 lb. In view of the fact that details have not been released by the operator the information is subject to correction. Total depth of the well is 9,265 ft., and 5½-in. casing was cemented at 8,984 ft. Salt water is reported to have been recovered when the well was tested at 8,907-09 ft., which apparently correlates with the discovery sand in the basal Frio.

TEXAS GULF COAST COMPLETIONS

Wildcats

Montgomery County: H. C. Cockburn 2 Foster, old well, dry, T.D. 7,773 ft.

Fields

Camp Eleven, Tyler County: American Republics 2 Cushing fee, 575 bbl., ¼-in. choke, perf. casing 7,997-8,007 ft., T.D. 8,008 ft.

Hull, Liberty County: American Republics 158 Dolbear, old well, 250,000 cu. ft. gas, perf. casing 2,260-90 ft., T.D. 2,959 ft.

Lolita, Jackson County: Skelly 3-B Mitchell, dry, T.D. 5,966 ft.

Lovells Lake, Jefferson County: Humble 34 Broussard, 84 bbl., ⅛-in. choke, perf. casing 7,719-21 ft.

North Markham, Matagorda County: Ohio 16 J. C. Carlson, 213 bbl., ⅛-in. choke, perf. casing 7,728-33 ft., T.D. 8,125 ft.

Stowell, Jefferson County: Glenn McCarthy 1 E. A. Englin, 175 bbl., ¼-in. choke, perf. casing 8,420-23 ft., T.D. 9,265 ft.

(Continued on Page 263)

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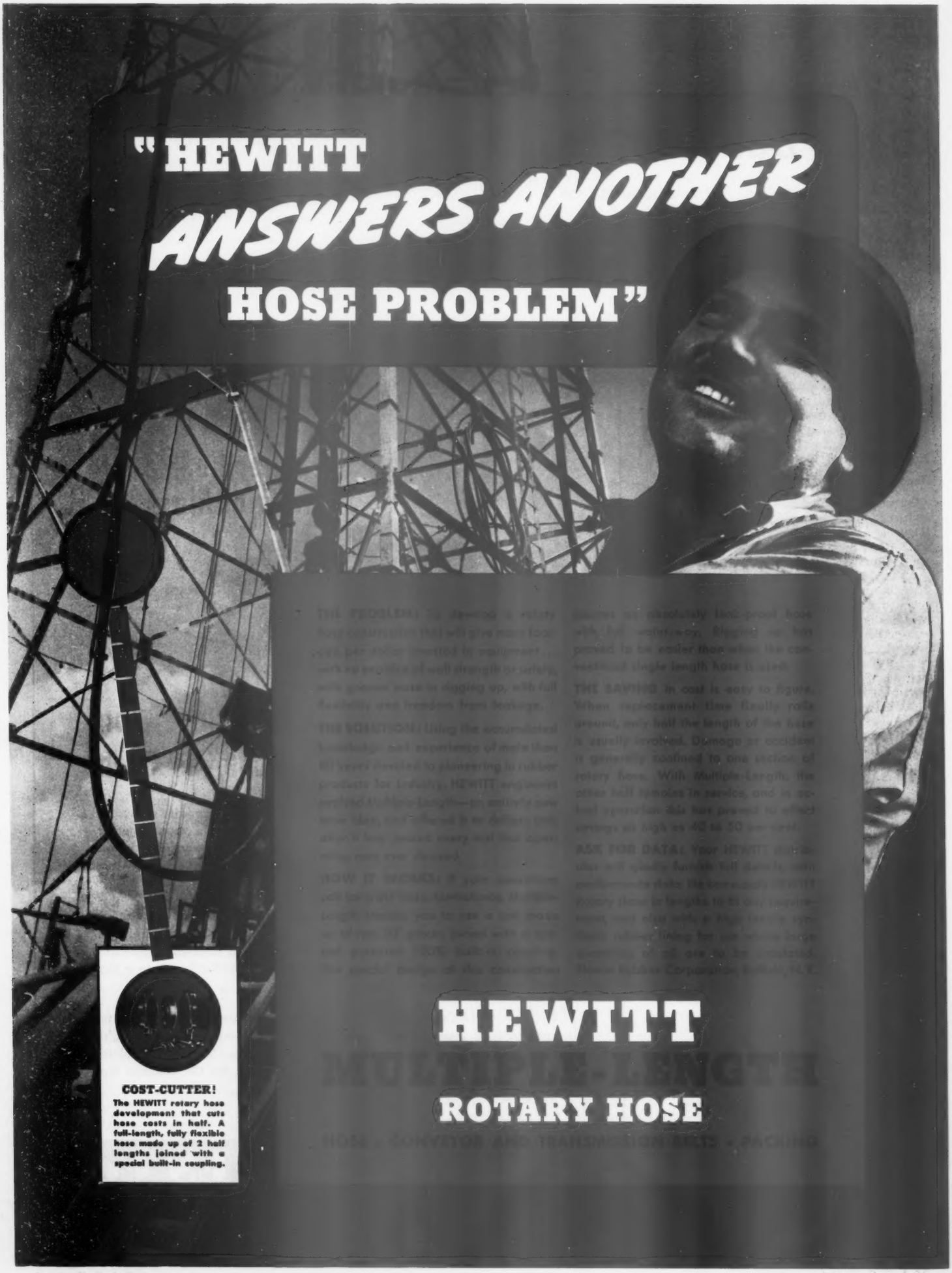
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Two Shallow Pools Opened Near Spencer, Ward County

By ROBERT INGRAM

MIDLAND, Tex.—Two new shallow pools were opened in Ward County last week, one 3½ miles northwest of the new shallow Spencer pool, the other about 3 miles south. All three were reef lime pools, and may be expected to join eventually.

On the northwest, Darby Petroleum Co. 1 University, Section 19, Block 16, University lands, flowed at the estimated rate of 25 bbl. an hour through ⅝-in. bottom choke on a drill-stem test. When pipe was broken down, it held about 2,500 ft. of oil with no water, and the pay was said to contain sufficient gas to make a flowing well.

From an elevation of 2,614 ft., the well topped the Yates sand at 2,560 ft., the frosted grains at 2,585 ft. and the first oil stained lime at 2,825 ft. The saturated section was topped at 2,827 ft. It cut a core from 2,837-47 ft. with a recovery of 5 ft. of porous oolitic dolomite showing saturation. Operator then ran the drill-stem test from 2,817-47 ft. It started flowing after 22 minutes, continued for the remaining hour of the test.

At week's end a string of 5½-in. casing had been set at 2,817 ft. with 250 sacks of cement, and plans were to run 2-in. tubing for natural completion at a total depth of 2,847 ft. Discovery of the new pool was credited to D. C. De Vito, Midland geologist, who was also credited with discovery of the Spencer pool itself. He assembled both blocks.

Meantime, Stanolind Oil & Gas Co., who drilled the Spencer pool discovery well, were taking official gages on Stanolind 1 H. L. Byrd, Section 34, Block 34, H. & T. C. Survey, 3 miles south of the Spencer area, another discovery. The well flowed 29 bbl. of oil on a 24-hour test through ⅛-in. choke. It was producing from a plugged-back total depth of 2,679 ft. where it had been shot with 105 qt. in pay from 2,637-79 ft.

Shipley Extended

The Shipley area, also in Ward County, had an extension indicated ½ mile east of J. N. Snowden et al 5-A Wristen, Section 18, Block 5, H. & T. C. Survey. The well had a show of oil at 2,457-80 ft., filled with oil at 2,510 ft. and then flowed after a control head was installed. The hole was drilled to a total depth of 5,212 ft. where it was testing.

Still farther south and east, M. D. O'Quinn et al staked 1 C. A. Nichols, Section 5, Block 6, H. & T. C. Survey.

Big Lake Allowable Hearing

Operators of the Big Lake Oil Co. 19-C University, discovery well of a new and fourth pay zone in the Big Lake oil field in Reagan County, asked the Railroad Commission last week for a new-field allowable. Testimony was presented to show that production from the 4,305-ft. level was a separate horizon and should therefore be classed as a new field.

The Plymouth Oil Co. presented evidence showing that oil from that level had a gravity of 42.4 while crude from the 2,900-ft. horizon in the same field had a gravity of 35 to 37. The two zones are separated by an impermeable shale formation, it was stated. The 19-C University is the only well producing from the 4,305-ft. zone. It was given a potential of 3,423 bbl., flowing, on February 16, last.

Other Tests

Humble Oil & Refining Co. 1-B J. W. Owens et al, which showed as limiting the Clara Couch pool in Crockett County the previous week, (see The Oil and Gas Journal, March 19, 1942) recovered 2½ bbl. after a second acid treatment, was still swabbing and testing at 1,915 ft. at week's end. . . . Amerada 1-H J. S. Todd estate, Crockett County, 1 mile north of 1-C Todd which extended the Todd field 2¾ miles west, was headed for the Ellenburger after it recovered sulfur water from the crinoidal zone at 6,360-6,500 ft., regular producing zone for the Todd Deep pool. . . . Testing was under way at Magnolia Petroleum Co. 1 State-Loar, 1 mile south outpost to Pecos County's Abell Ordovician field, which topped the Simpson at 4,945 ft., the Tulip Creek at 5,145 ft. and the Waddell at 5,854 ft. Although this top for the Waddell was correlated by some as 92 ft. high to Magnolia 5 State-Silverman, a large Waddell sand producer to the northwest, the 1 State-Loar found that section dry and was testing below 5,880 ft.

Extensive Wildcatting Program Under Way in Andrews County

Lion's share of the inside drilling in northern West Texas has been in the Slaughter pool for months and last week most of the wildcatting was concentrated in Andrews County. There were six tests drilling in Andrews County, none with important developments. They were:

Fullerton 2 Wilson, drilling below 5,450 ft. in lime, and Fullerton 3 Wilson, drilling at 4,400 ft. in lime and anhydrite, both in Section 15, A-32, P.S.L. Survey, in the vicinity of the Fullerton 1 H. M. Wilson, deep Permian lime discovery; Magnolia 1 Ralph, Section 11, A-32, P.S.L. Survey, northwest outpost to the Fullerton area, drilling at 4,955 ft.

Seaboard Oil Co. 3 M. A. Thornberry, Section 13, A-43, P.S.L. Survey, northeast outpost to the West Furhman pool, drilling at 3,648 ft. in anhydrite and sand.

Phillips Petroleum Co. 1-A University-Andrews, southwestern Andrews County, Section 30, Block 10, University lands, drilling at 6,003 ft.; Mascho Oil Co. 1 Sun-University, Section 27, Block 10, University lands, 2 miles northwest of the Emma pool, fishing at 1,760 ft. in anhydrite; and Texas Pacific Coal & Oil and Seaboard Oil Corp. 1-D Midland Farms, Section 46, Block 40, Township 2n, G.&M.M.B.&A. Survey, drilling below 5,100 ft. in porous lime without shows.

Slaughter Edge Tests

George P. Livermore, Inc., of Lubbock, abandoned 1 J. E. Mabee in Terry County, 1½ miles south of production in the Slaughter pool after finding sulfur water (see completions). On the northwest edge of the Slaughter field, Continental Oil Co. 1 Dean, League 58, Martin County School Land Survey, Cochran County (see completions) flowed 788 bbl. a day for another good well.

NORTHERN WEST TEXAS COMPLETIONS

Wildcats

Garza County: M. L. Richards 1 W. L. Sullivan, K, Aycock Sur., 2¼ mi. SW of Post, location abandoned.

Terry County: George P. Livermore 1 J. E. Mabee et al, 510 ft. from N and E lines, Sec. 20, Blk. D-11, 1½ mi. S of Slaughter, dry, Anhydrite 2,400 ft., San Andres 4,430 ft., T.D. 5,316 ft.

Fields

Slaughter, Cochran County: Continental 1-58 C. S. Dean, elev. 3,694 ft., flowed 772 bbl., cut 3 per cent b.s., through tubing, acid, pay 4,946 ft., T.D. 4,995 ft.

Magnolia 12-C Mallett, elev. 3,642 ft., flowed 1,195 bbl. through 3-in. casing outlet, acid, pay 5,000 ft., T.D. 5,057 ft.

Slaughter, Hockley County: Honolulu 21-B Mallett, elev. 3,621 ft., flowed 1,034 bbl. through 2½-in. casing outlet, acid, pay 4,960 ft., T.D. 5,020 ft.

Magnolia 9-B Mallett, elev. 3,638 ft., flowed 1,618 bbl. through 3-in. casing outlet, acid, pay 4,985 ft., T.D. 5,020 ft.

Magnolia 13-B Mallett, elev. 3.629 ft.. flowed 1,109 bbl. through 3-in. casing outlet, acid, pay 4,935 ft., T.D. 5,015 ft.

Magnolia 19-B Mallett, elev. 3,629 ft., flowed 1,261 bbl. through 3-in. casing outlet.

Texas 113 Slaughter, elev. 3,566 ft., flowed 1,811 bbl. through casing, acid, pay 4,969 ft., T.D. 5,046 ft.

Texas 115 Slaughter, elev. 3,555 ft., flowed 696 bbl. oil plus 3 per cent water through tubing, acid, pay 4,995 ft., T.D. 5,025 ft.

Texas Pacific Coal & Oil 2 Graham, elev. 3,553 ft., flowed 450 bbl. through casing, acid, pay 4,890 ft., T.D. 4,962 ft.

Western States 17 Frazier, elev. 3,520 ft., flowed 2,095 bbl. through 2½-in. casing outlet, acid, pay 4,922 ft., T.D. 5,010 ft.

Wasson, Yoakum County: American Liberty Oil 6 Elliott, elev. 3,641 ft., flowed 239 bbl. oil plus 11 per cent water through tubing on gas lift, acid, pay 4,990 ft., T.D. 5,229 ft.

American Liberty 3 Herd, elev. 3,666 ft., flowed 346 bbl. oil plus 13 per cent water through tubing, acid, pay 5,050 ft., T.D. 5,246 ft.

Gulf 4 Futch, elev. 3,640 ft., flowed 662 bbl. through tubing, acid, pay 5,148 ft., T.D. 5,180 ft.

SOUTHERN WEST TEXAS COMPLETIONS

Fields

Abell (Ordovician), Pecos County: Magnolia 4 Markey heirs, location abandoned.

Magnolia 1 McIntosh-State, elev. 2,391 ft., flowed 671 bbl. natural through ½-in. tubing choke, pay 5,476 ft., Simpson 5,055 ft., McKee 5,435 ft., T.D. 5,484 ft.

Magnolia-Stanolind 1 Sharp-State, elev. 2,396 ft., dry, T.D. 5,932 ft.

Barnhart, Reagan County: Amerada 1 R. F. University, location abandoned.

Crockett, Crockett County: O. R. Tipps, trustee, 6 University, flowed 85 bbl. natural through tubing, pay 1,449 ft., T.D. 1,452 ft.

O. R. Tipps, trustee, 9 University, flowed 32 bbl. oil plus 15 per cent water natural through tubing, pay 1,390 ft., T.D. 1,462 ft.

Emperor, Winkler County: Skelly 46 Halley, elev. 2,770 ft., flowed 525 bbl. through ¾-in. choke, shot 2,755-2,890 ft., T.D. 2,890 ft.

Estes, Ward County: Gulf 168 Hutchins, flowed 417 bbl. through casing, shot, pay 2,683 ft., T.D. 2,764 ft.

Foster, Ector County: Sunray 4 Bagley, elev. 2,936 ft., flowed 5,108 bbl. natural through casing and tubing, pay 4,280 ft., T.D. 4,395 ft.

C. O. Davis et al 4 Judkins, elev. 2,952 ft., flowed 3,020 bbl. natural through casing, pay 4,290 ft., T.D. 4,423 ft.

Drilling & Exploration 2 Kone et al, flowed 404 bbl. through ⅞-in. tubing choke, shot, pay 4,265 ft., T.D. 4,372 ft.

Sinclair Prairie 10 Gist, elev. 2,969 ft., dry, T.D. 4,360 ft.

Sinclair Prairie 37-C Johnson, elev. 3,029 ft., dry, T.D. 4,252 ft.

Keystone, Winkler County: Richardson & Bass 3 Ben Jenkins et al, elev. 2,964 ft., flowed 306 bbl. through 1-in. tubing choke after shot, pay 3,290 ft., T.D. 3,401 ft.

Standard of Texas 45-13 Baird, flowed 308 bbl. through 2-in. casing outlet, shot 3,170-3,300 ft., pay 3,200 ft., T.D. 3,318 ft.

McElroy, Upton County: Gulf 268 McElroy, elev. 2,800 ft., flowed 502 bbl., pay 2,980 ft., T.D. 3,208 ft.

North Cowden, Ector County: Texas 22 Holt, elev. 3,102 ft., flowed 766 bbl. through tubing, shot, pay 4,410 ft., T.D. 4,715 ft.

Sand Hills (Permian), Crane County: Humble 6-C Tubb, 9,240,000 cu. ft. gas, pay 4,500 ft., at 4,538 ft. after acid tested 16 bbl. of fluid per day cut 15 per cent b.s., T.D. 4,583 ft.

Magnolia 11 Lea, elev. 2,627 ft., flowed 148 bbl. through ½-in. tubing choke, acid, pay 4,385 ft., T.D. 4,567 ft.

Waddell, Crane County: Gulf 52 Waddell, elev. 2,769 ft., flowed 9,494 bbl. through casing and tubing, acid, pay 3,487 ft., T.D. 3,493 ft.

SOUTHEAST NEW MEXICO

HOBBS, N. M.—Completion of a large flush producer in the West Eunice pool of Lea County and opening of a new shallow area in Eddy County about 4 miles west of the Getty pool featured Southeast New Mexico oil development last week.

(Continued on Page 273)

APPALACHIAN FIELDS

Operations Slowed Down by Spacing Regulations

PITTSBURGH, Pa., Mar. 18. — Except for the Oriskany fields in West Virginia, completions in the lower eastern fields were unimportant and total 18, of which 4 were dry and 14 were gas wells. The drain on Pennsylvania Grade crude stocks continues and so far there is little evidence that additional pools or even extensions will be discovered. Extensions to pools in many areas require abolition of the present spacing, and independent operators, who are foremost in wildcatting, still view the price limitations. The secondary recovery in the Bradford and Allegany districts offers the only hope of a continued adequate supply.

On the Fayette anticline in South Huntington Township, Fayette County, Peoples Natural Gas Co. is drilling at 7,602 ft. in the test on the Jacobs Creek Oil Co. This is 285 ft. below the top of the Onondaga lime which is appearing unexpectedly thick.

On Chestnut Ridge in South Union Township, Peoples Natural Gas Co. is drilling at 8,149 ft. in 4 Piedmont Coal Co., 34 ft. below the top of the Onondaga lime. Drilling has been slow. Their 1 Piedmont Coal, recently deepened, after being shut in for pressure test, rocked up to 1,110 lb.

Here New Penn Development Co., William E. Snee, et al are drilling out cement at 7,475 ft. in 1 Kirby, 488 ft. below the Tully lime. These operators have started deepening 1 Heyn, the discovery well, and are cleaning out a bridge at 6,325 ft. which developed after the hole was shot. On Laurel Ridge, in Ligonier Township, Fayette County, these operators are building the rig for the deep test on the John E. and Eleanor Beck farm.

In Greene County, Natural Gas Co. of West Virginia is continuing to drill through the Oriskany sand in the test on the Andrew Workman farm on the Washington anticline in Richhill Township. The sand has hardened but no more salt water has come in. The present depth is 7,061 ft., 45 ft. below the top of the Oriskany sand.

In Lawrence County, John T. Galey et al skidded the rig for a new start in the Oriskany test of the Miller & Myers lease in Slippery Rock Township, after a bad fishing job in the Murrays-ville sand at 795 ft.

Armstrong County, Plum Creek Township: T. W. Phillips 1 E. J. Elgin, 119,000 cu. ft. gas, Hundred-foot, Thirty-foot, and Tiona sands, T.D. 3,271 ft.

Clarion County, Red Bank Township: Hanley & Bird 1 J. A. Silvis, dry, through Speechley sand, T.D. 3,348 ft.

Fayette County, Menallen Township: J. H. Cornell 1 G. F. Newman, dry, through Fifth sand, T.D. 3,255 ft.

Greene County, Richhill Township: D. A. Null et al 1 Homer Gillespie, 59,000 cu. ft. gas; Fifty-foot sand 2,560-72 ft., gas 2,562 ft., Gordon stray 2,610-35 ft., gas 2,615-18 ft., T.D. 2,819 ft.

Westmoreland County, Bell Township: Kiski Valley Gas Co. 1 M. Householder, drilled deeper, 179,000 cu. ft. gas, started deepening 1,945 ft., Speechley 2,970-78 ft., gas 2,971 ft., T.D. 3,700 ft.

WEST VIRGINIA COMPLETIONS

Boone County, Scott district: Owens, Libby-Owens 38 Cassingham Coal Lands Co., 77,000 cu. ft. gas; Big lime 1,739-1,934 ft., Injun 1,934-69 ft., Berea 2,417-44 ft., R.P. 262 lb., T.D. 2,475 ft.

Calhoun County, Sherman district: Hope 3732 Laurel McDonald, 10 bbl., Injun sand, T.D. 2,007 ft.

Hope 8590 W. F. Barns, dry, Big lime 1,754-1.843 ft., Injun 1,843-1,904 ft., T.D. 1,958 ft.

Lincoln County, Union district: Fez Gas Co. 2 John V. Pack, drilled deeper, 103,000 cu. ft. gas, start 2,232 ft., brown shale 3,233-3,503 ft., shot 2,923-3,523 ft., T.D. 3,523 ft.

Marion County, Paw Paw district: Owens, Libby-Owens 1 Lulu Shuman, 96,600 cu. ft. gas, Pittsburgh Coal 931-38 ft., Fourth sand 3,166-88 ft., T.D. 3,170 ft.

Ritchie County, Murphy district: Creed Barker 1 John Nutter, dry; Maxton sand 1,670-1,719 ft., Big lime 1,807-88 ft., T.D. 1,964 ft.

Wayne County, Grant district: Owens, Libby-Owens 25 Hoard-Baldwin, 379,000 cu. ft. gas, Big lime 1,015-1,195 ft., Injun 1,195-1,263 ft., gas 1,085 ft., shot 1,238-66 ft., T.D. 1,266 ft.

ORISKANY GAS FIELDS

Jackson County, Ravenswood district: Carnegie et al 1 G. L. Cabot, Inc., Mineral, 14,930,000 cu. ft. gas; Salt sand 1,657-1,735 ft., Big lime 1,735-1,853 ft., Injun 1,856-1,954 ft., Berea 2,344-70 ft., Corniferous 4,841-4,961 ft., Oriskany 4,961 ft., shot 4,956-96 ft., T.D. 4,996 ft.

Ripley district: Mullins Gas Co. 1 Myrtle P. Conant, 19,495,000 cu. ft. gas, Salt sand 1,712-1,820 ft., Big lime 1,890-1,956 ft., Injun 1,956-84 ft., Corniferous 4,952-5,064 ft., after 10 hours open blew down to 14,930,000 cu. ft. gas, R.P. 1,800 lb., T.D. 5,065 ft.

Spartan Gas Co. 1 N. S. Thomas heirs, 6,564,000 cu. ft. gas; Salt sand 1,260-1,550 ft., Maxton 1,550-1,700 ft., Big lime 1,700-1,849 ft., Injun 1,849-89 ft., Berea 2,280-90 ft., Corniferous lime 4,825-4,937 ft., Oriskany 4,937 ft., shot 4,937-71 ft., T.D. 5,065 ft.

United Carbon Co. 996 D. F. Hyre, 381,000 cu. ft. gas, Salt sand 1,215-1,675 ft., Maxton 1,675-1,750 ft., Big lime 1,750-1,850 ft., Injun 1,850-1,900 ft., Berea 2,320-30 ft., Corniferous 4,858-4,967 ft., Oriskany 4,967 ft., shot 4,968-90 ft., T.D. 4,990 ft.

Washington district: Hope 8585 B. M. Pfost, 6,472,000 cu. ft. gas, Big lime 1,960 ft., Berea 2,517 ft., Corniferous 5,122 ft., Oriskany 5,231 ft., shot 5,231-51 ft., R.P. 1,830 lb., T.D. 5,251 ft.

Kanawha County, Poca district: Poca Fork Oil & Gas Co. 1 Lewis Painter, 1,220,000 cu. ft. gas, Big lime 1,753-1,890 ft., Corniferous 5,073 ft., Oriskany 5,216 ft., shot 5,216-70 ft., T.D. 5,337 ft.

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Drilling Picks Up Slightly After Several Quiet Weeks

By CARL HOOT

KANSAS field activity was considerably brighter than it has been for several weeks, with the successful completion of several wildcats and pool extensions. Five new wildcat tests were staked, one each in Ellis, Rooks, Pratt, Trego, and Saline counties. There were 34 wildcats drilling throughout the state.

Pawnee County Has New Pool

Stanolind Oil & Gas Co. 1 Smith, N½ SE SE 16-23-16w, flowed 122 bbl. of fluid cutting 25 per cent water in 26 hours. Total depth of the well is 4,121 ft. Tops logged were Lansing 3,621 ft., conglomerate 3,989 ft., Simpson 4,025 ft., Arbuckle 4,066 ft. Pay is from the Arbuckle.

Barber County Wildcat Completed as Gasser

Champlin Refining Co. 1 Hildebrand, CEL NE NW 26-32-15w, flowed 14,000,000 cu. ft. of gas a day from the Viola lime at 4,931 ft. after acid treatment. Cement was drilled to 4,950 ft. and casing perforated from 4,925-40 ft. The well may open a new gas pool in Barber County. Location is about 2 miles south of the town of Deerhead and some 12 miles northwest of the Medicine Lodge pool.

DAILY AVERAGE PRODUCTION

LEADING KANSAS FIELDS

	Mar. 21	Mar. 14
Augusta	1,150	1,200
Bemis-Shutts	11,450	11,150
Bloomer	5,500	6,200
Burnett	7,850	10,250
Burrton	6,150	6,400
Chase	5,050	4,800
Elbing	850	900
El Dorado-Towanda	6,700	6,900
Geneseo	6,150	5,950
Graber	2,850	2,100
Greenwood County	8,300	8,550
Hollow-Nikkel	1,200	1,200
Keesling-Midway	850	550
Lerado	300	100
Lorraine	650	1,350
Oxford	500	450
Rainbow Bend	750	800
Raymond	1,000	1,750
Ritz-Canton	3,350	3,400
Trapp	20,050	21,350
Balance Russell County	23,450	24,250
Sedgwick County	2,750	2,750
Silica	18,200	19,400
Voshell	1,600	1,600
Wellington	700	750
Wherry	2,000	1,400
Zenith	8,300	11,150
Others	81,100	77,750
Total Kansas	228,750	234,400

Old Pools Extended

The Kraft-Prusa area of Barton County apparently gained a ¾-mile westward extension when Black-Marshall 1 Dolecheck, SE cor. 24-16-12w, had 1,500 ft. of oil in the hole after drilling to 3,376 ft. Conglomerate was topped at 3,360 ft. and sand at 3,364 ft. Operators were setting casing to test.

In Rice County the new Smyers' area was extended ¾ mile north by the Nelson Drilling Co. 1 Anderson, NW SE SW 25-19-6w, which flowed 420 bbl. of oil a day from the Mississippi lime topped at 3,336 ft.

The Dayton pool of Phillips County was extended ¼ mile southwest by the Carter Oil Co. 1 Dusin, SE SE 25-2-19w. The well made temporary potential of 272 bbl. of oil a day from the Lansing-Kansas City lime at 3,312 ft., after acidizing.

In Reno County the Lion Oil Refining Co. 1 Brinkman, SW SE NW 2-23-10w, extended the Hendrickson pool a half mile southeast when it filled 2,200 ft. with oil in 12 hours after drilling plug in the Viola lime. Total depth is 3,723 ft.

Other Wildcats Active

In Barton County, 1 mile northeast of the Hammer pool, E. B. Shawver 1 Berscheidt, SW NW NW 25-19-12w, had a small amount of oil in the Arbuckle at 3,372 ft. after drilling plug at 3,369 ft. Five-inch casing was set at 3,372 ft. and operators were rigging up cable tools for testing.

In Rush County, ½ mile south of the old Madden field and 12 miles north of La Crosse, Luther Mackall 1 Herrman, E½ SE NE 2-16-18w, had showing of oil at 3,552 ft. and was running 5-in. casing. Tops logged were Florence 2,190 ft., Lansing 3,265 ft., conglomerate 3,521 ft.

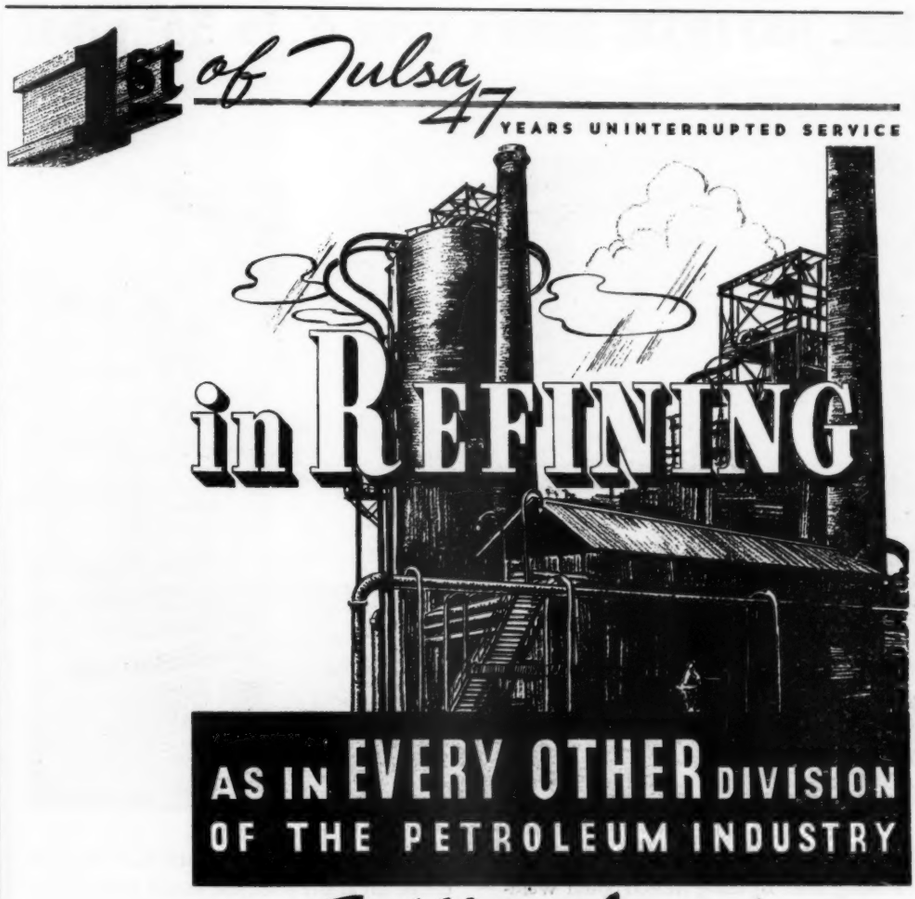
Simpson Oil 1 Souder, SW NE NE 32-23-10w, Reno County, flowed an estimated 75,000,000 cu. ft. of gas at total depth of 3,731 ft. which was killed by plugging back to 3,670 ft. in the Viola.

KANSAS COMPLETIONS

Wildcats

Leavenworth County: E. V. Jackson 1 Winkler, SE NW 34-7-20, location abandoned.

(Continued on Page 264)



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SOUTHWEST TEXAS

New Wilcox Production Found Near Yorktown, De Witt Co.

By F. L. SINGLETON

CORPUS CHRISTI, Tex.—The southwest sector of the Wilcox trend gained another gas-distillate field with the testing of Adams Oil & Gas Co. et al 1 H. Berck, located 3 miles east of the town of Yorktown in the J. Kimberling Survey. With the hole bottomed at 9,150 ft., 5½-in. casing was cemented at 7,328 ft., and the well was tested through perforated casing at 7,208-12 ft. At the end of 30 minutes working pressure had risen to 1,900 lb., it was estimated to be flowing at the rate of 6 bbl. of 63-gravity distillate per hour and 1,800,000 cu. ft. of gas through various chokes. The Wilcox was topped at 7,070 ft., and casing was cemented for testing after an electrical survey and side-wall cores showed favorable indications. At the end of the week the well was shut in, waiting on orders and it was not announced whether further tests will be made. This is the second Wilcox field for the county and is located approximately 16 miles northwest of the Thomaston field.

South Caesar Development Expected in Near Future

Development in the new South Caesar field, Bee County, was expected to be resumed in the near future with the reported purchase of approximately 2,400 acres by the Atlantic Refining Co. from Tom Slick, Jr. The deal is said to involve a consideration of $100,000 including the discovery well with the Slick interest retaining an overriding royalty interest of one-quarter of the seven-eighths. Locations have been made for three wells and actual drilling is being delayed while titles are being examined. Production was recently opened in the area from the Carrizo sand at 6,552-57 ft.

Humble 1 King-Arroyo, 1 mile west of the Stratton field in Kleberg County, was still in the process of completion. Casing was perforated at 6,193-97 ft., and the well was swabbing 15 per cent oil and 85 per cent salt water. In the same area, the company's 2 King-Arroyo was drilling in shale below 6,885 ft., following a 16-minute drill-stem test at 6,761-71 ft. which tested 575 lb. working pressure and recovered 45 bbl. of distillate-cut mud.

Corpus Christi Area Gains New Wildcat Locations

The Corpus Christi area gained three new wildcat locations, all of which are projected 7,500-ft. tests. South of the Clarkwood townsite L. A. Douglas et al is rigging up for 1 Allen in the J. H. Smith Survey, while 2 miles southwest of the Shield field, Morgan-Wynne & Morgan announced location for 1 Girdes et al in the D. M Oliver Survey. Two miles west of Bishop, Southern Minerals Corp. is moving in material for 1 E. G. Whitten in the Palo Alto Survey.

In the south extension area of the Seeligson field, Jim Wells County, Shell Oil Co., Inc., was preparing to cement casing in 2 Seeligson. Total depth of the well is 6,000 ft. with electrical survey's showing favorable indications. Correlated with 1 Seeligson, the well is about 12 ft. structurally higher.

West of the Midway field, San Patricio County, F. M. Boykin was expected to halt drilling in 1 Reed, 1 mile west of the field, and cement casing for testing following a drill-stem test at 6,100 ft., which recovered several hundred feet of pipe-line oil. The same operator opened production from this sand on the east side of the field last year, but development has been limited to a few wells, and the extent of the sand has been more or less undetermined.

Gas Field in Prospect South of McLean

The Laredo area was assured of a gas field by the showing of O. W. Killam and Midstates Oil Co. 2 Puig, a wildcat located 2½ miles south of the McLean field in the Albercas grant. While the well is drilling ahead in shale below 3,195 ft., an 18-minute drill-stem test at 2,208-43 ft., tested 2,500,000 cu. ft. of gas with no show of oil or salt water. Tight sand was cored at 2,208-36 ft., while porous sand showing free oil was cored at 2,236-41 ft.

In Bastrop County, Marts & Bean were attempting to revive production in the Elgin area as preparations were made to test 1 William McWilliams, located in the George J. Glasscock Sur-

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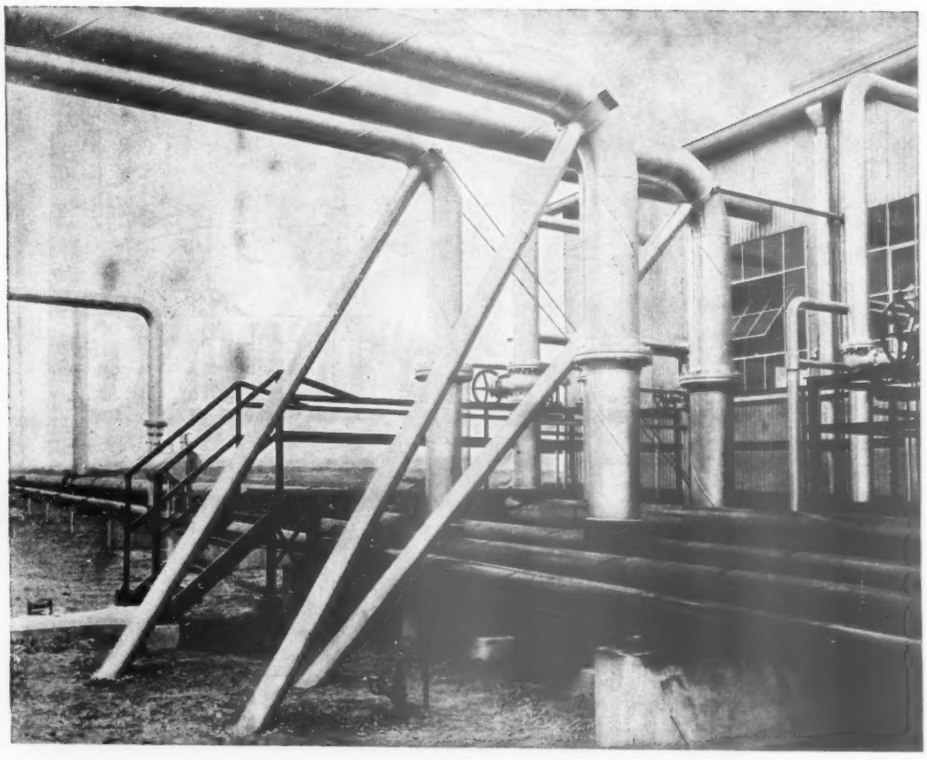

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vey. Austin chalk showing oil was cored at 2,230-50 ft., and the hole is bottomed at 2,370 ft., with 5½-in. casing cemented at 2,210 ft. Production was opened in this area several months ago but was short lived.

About 2 miles southeast of the town of St. Hedwig, V. E. Nicholson 1 Skrycky, William McNenner Survey, cored sand showing oil at 1,336-48 ft., and the well was drilled to a total depth of 1,364 ft. before casing was cemented for testing at 1,334 ft. At the end of the week the well was shut down for orders after it swabbed drilling mud with a show of oil.

SOUTHWEST TEXAS COMPLETIONS

LOWER GULF COAST DISTRICT

Wildcats

Nueces County: Crown Central 1 Womack, dry, T.D. 7,510 ft.

Victoria County: Continental 1 Welder, dry, T.D. 6,525 ft.

Fields

Agua Dulce, Nueces County: Richardson Petroleum Co. 10 McCoy, 72 bbl., ⅞-in. choke, perf. casing 6,446-50 ft., T.D. 7,058 ft.

Ben Bolt, Jim Wells County: Bridwell 7 Smith, 252 bbl., ⅞-in. choke, perf. casing 4,800-08 ft., T.D. 4,810 ft.

Bridwell 8 Smith, dry, T.D. 5,480 ft.

East Placedo, Victoria County: W. L. Goldson 4 West, 110 bbl., 3/32-in. choke, perf. casing 6,868-70 ft., T.D. 6,920 ft.

Odem, San Patricio County: Seaboard 4 Bonner, 119 bbl., ⅛-in. choke, perf. casing 5,303-07 ft., T.D. 5,308 ft.

Orange Grove, Jim Wells County: Kilgore Developers 2 Koehn, dry, T.D. 5,110 ft.

Plymouth, San Patricio County: Plymouth 123-C Welder, 121 bbl., ⅛-in. choke, perf. casing 5,652-58 ft., T.D. 6,168 ft.

Seeligson, Jim Wells County: Sun 6 Canales, 122 bbl., 7/64-in. choke, perf. casing 5,972-77 ft., T.D. 6,000 ft.

Springfield, Jim Wells County: Bruce Baxter 1 Koopman, 50 bbl., 7/64-in. choke, perf. casing 4,115-22 ft., T.D. 6,008 ft.

Stratton, Nueces County: Texon Royalty 6 Eliff, 140 bbl., ⅞-in. choke, perf. casing 5,715-30 ft., T.D. 5,900 ft.

LAREDO DISTRICT

Wildcats

Duval County: Wellington 2 Glasscock, dry, T.D. 6,780 ft.

Starr County: Sun 1 Ramirez, dry, T.D. 4,410 ft.
Moss & Bishop 3 Ricaby, dry, T.D. 1,767 ft.

Fields

Aviator, Webb County: O. W. Killam 1 Benavides, dry, T.D. 3,525 ft.

Mills Bennett 2 Benavides, dry, T.D. 2,465 ft.

East Cole, Duval County: Henshaw 1 Vivanco, dry, T.D. 1,787 ft.

Garcia, Starr County: Sun 1 Garcia Land & Livestock Co., 196 bbl., 5/32-in. choke, perf. casing 3,748-53 ft., T.D. 4,076 ft.

Hoffman, Duval County: Magnolia 27 Well. 157 bbl., ⅝-in. choke, sand 2,653-55 ft., T.D. 2,655 ft.

Kreis, Duval County: Highland 1 Dee, dry, T.D. 3,374 ft.

Oakville, Live Oak County: Hewitt & Dougherty 1 Reagan, 72 bbl., ⅞-in. choke, perf. casing 2,735-30 ft., T.D. 2,840 ft.

Rincon, Starr County: Continental 65-B Slick, 216 bbl., ⅞-in. choke, perf. casing 4,127-36 ft., T.D. 4,142 ft.
Continental 115-A Slick, 214 bbl., ⅞-in. choke, perf. casing 4,012-27 ft., T.D. 4,201 ft.

SOUTH CENTRAL TEXAS DISTRICT

Wildcats

Milam County: R. D. Kirkland 1 Graves, dry, T.D. 1,695 ft.

Wilson County: H. A. Suttle 1 Hardy, dry, T.D. 4,941 ft.

Fields

Bee Creek, Caldwell County: Ralph Ogden 10-B Miears, dry, T.D. 4,237 ft.

Chittim, Maverick County: Wellington-Humble 2 Chittim, casing collapsed, junked, T.D. 5,706 ft.

Floresville, Wilson County: H. J. Baker, dry, T.D. 310 ft.
H. J. Baker 3 Meyers, dry, T.D. 620 ft.

Sisterdale, Kendall County: York 6 Werner, dry, T.D. 1,034 ft.

Texas Gulf Coast

(Continued from Page 257)

Texana, Jackson County: Gulf 1 Simon, top Discorbis 4,594-4,624 ft., Eponides 4,744-74 ft., Heterostegina 4,894-4,924 ft., round Marginulina 4,990-5,000 ft., dry, T.D. 7,801 ft.

Withers, Wharton County: F. W. Michaux 32-A Pierce, 143 bbl., 5/32-in. choke, perf. casing 5,340-44 ft., T.D. 5,378 ft.
F. W. Michaux 55-A Pierce, 155 bbl., 5/32-in. choke, perf. casing 5,330-43 ft., T.D. 5,370 ft.
F. W. Michaux 72-A Pierce, 152 bbl., 5/32-in. choke, perf. casing 5,330-37 ft., T.D. 5,376 ft.
F. W. Michaux 75-A Pierce, 165 bbl., 5/32-in. choke, perf. casing 5,336-44 ft., T.D.. 5,369 ft.

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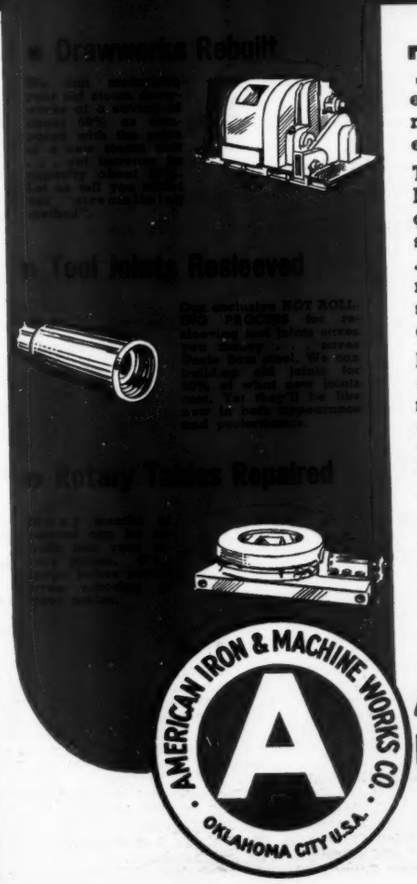

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Four Possible Pool Openers In Central Basin Area

MATTOON, Ill.—A new pool was added to the long list of Wayne County fields last week and three other counties had wildcat tests which were showing for possible pool openers.

The Wayne County pool opener was the First National Petroleum Trust 1 J. W. Ellis, SW NE 18-1s-5e, 8 miles from nearest production in the Johnsonville pool. Operators set casing to Aux Vases saturation at 2,910-28 ft. and after plug was drilled the well swabbed natural at the rate of 37 bbl. an hour. This production was maintained for several hours. The well will be put on pump for an initial test.

No. 1 Ellis was drilled to the St. Louis at 3,175 ft. but was plugged back to the Aux Vases saturation. Because the well is having no water trouble and is producing from the long-lived Aux Vases sand it will probably rank as one of the major discoveries of the year.

Another possible pool opener in the county is the New Penn Development 1 L. P. Harris, W½ NW NE 28-2s-9e, about 1½ miles southeast of the Golden Gate field, where saturation in the Rosiclare and Levias will be tested. On a 1-hour drillstem test 2,100 ft. of oil and no water were recovered. The Levias saturation was at 3,280-89 ft.

Pure has staked two other locations in the area, 1 Fisher in the NW NW 27-2s-9e, and 1 Simpson in the NE SE 21-2s-9e.

Perry County Joins Oil Group

Perry County had its first producing well when the Harsh 1 Newborn, SE SE NW 22-4s-1w, pumped 16 bbl. of oil and 10 bbl. of water from the Cypress sand in a 24-hour test. No. 1 Newborn was completed in the Cypress at 1,130-50 ft. Magnolia Petroleum Co. has already staked location for an east offset to the pool opener. The test will be in SW NE 22-4s-1w.

Interest, however, is shifting rapidly away from Perry County since one test was dry last week and two more were pending abandonment. Within the next few weeks it is expected to center upon Marion County where more wildcats are pending than have been contemplated for several months. None on these is drilling at present, however.

Two McClosky Pools in Prospect

Casing has been set to test about 10 ft. of McClosky saturation at Craft & Powers 1 Benefiel, E½ SW NE 7-5n-14w, a wildcat about 1 mile southwest of the Ste. Marie pool in Jasper County.

Pure Oil Co. has set casing at a Richland County wildcat about 1½ miles east of the Clay City field, 1 Albert Grubb, W½ SW SE 36-3n-8e, at a total depth of 3,025 ft., preparatory to testing McClosky saturation.

ILLINOIS COMPLETIONS

Wildcats

Crawford County: Roy Powers 1 Park, N½ SW NW 20-8n-13w, dry at 1,080 ft., lost hole and skidded 25 ft. south.

Effingham County: Smith & Herbert 1 Kroeger, NE SE NE 36-8n-6e, dry at 2,587 ft., Kincaid 1,580 ft., Menard 1,800 ft., Tar Springs 1,908 ft., Glen Dean 2,017 ft., Golconda 2,043 ft., Barlow 2,141 ft., Cypress sand 2,220 ft., Benoist 2,322 ft., Renault 2,392 ft., Ste. Genevieve 2,460 ft., Rosiclare 2,474 ft., Fredonia 2,496 ft., St. Louis 2,583 ft.

Franklin County: J. W. Menhall 1 Valier Coal, SE SW SE 1-6s-1e, dry at 2,860 ft., Menard 1,850 ft., Waltersburg 1,960 ft., Tar Springs sand 1,990 ft., Glen Dean 2,088 ft., Hardinsburg sand 2,132 ft., Golconda 2,196 ft., Barlow 2,318 ft., Cypress sand 2,366 ft., Benoist sand 2,558 ft., Renault 2,579 ft., Ste. Genevieve 2,638 ft., Rosiclare 2,701 ft., Fredonia 2,766 ft.

McDonough County: J. B. Bushnell 1 Newland, SW SE SE 4-4n-4w, dry at 535 ft., Mississippian lime 75 ft., Kinderhook 242 ft., Maquoketa 535 ft.

Marion County: N. W. Whitton 1 Anderson, NW NE SW 32-2n-1e, location abandoned.

Perry County: Shell 1 J. Schubert, N½ SW SE 23-4s-2w, dry at 3,014 ft., Menard 712 ft., Waltersburg 780 ft., Tar Springs 853 ft., Glen Dean 933 ft., Hardinsburg 960 ft., Golconda 1,001 ft., Barlow 1,106 ft., Paint Creek 1,223 ft., Benoist 1,300 ft., Aux Vases 1,374 ft., Ste. Genevieve 1,471 ft., Fredonia 1,516 ft., McClosky 1,539 ft., St. Louis 1,630 ft., Salem 1,816 ft., Osage 2,297 ft., Chattanooga 2,828 ft., Devonian 2,853 ft.

Wabash County: C. Seneff 1 Seiler, NW NE SW 27-1n-12w, dry at 1,683 ft., Biehl 1,456 ft., Vienna 1,659 ft., Tar Springs 1,672 ft.

Wayne County: Bell Bros. 1 R. Hand, E½ SW NW 11-3s-5e, dry at 3,422 ft., Kincaid 2,135 ft., Menard 2,400 ft., Vienna 2,526 ft., Tar Springs 2,536 ft., Glen Dean 2,633 ft., Golconda 2,735 ft., Barlow 2,867 ft., Cypress 2,894 ft., Renault 3,153 ft., Aux Vases 3,164 ft., Ste. Genevieve 3,225 ft., Fredonia 3,300 ft.

White County: Minerva Oil 1 Phil Ramsey, N½ SW NE 33-6s-10e, pumped 86 bbl. oil and 1 bbl. water, 15-qt. shot 2,906-15 ft., 20-qt. shot 2,904-12 ft., Aux Vases 2,904 ft., T.D. 2,917 ft., P.B. 2,914 ft., *pool opener.*

Fields

Allendale, Wabash County: Lustergarten 1 Millimax, NW NE NE 16-1n-12w, pumped 150 bbl., 1,000 gal. acid, McClosky 2,291-93 ft., old well P.B. from 2,307-04 ft.

(Continued on Page 272)

Kansas Fields

(Continued from Page 261)

Jefferson County: W. D. Dunn 1 Boyd, NE NE SE 22-8-19, location abandoned.

Greenwood County, 2 miles north of Bunyard field in Elk County: C. P. Welch 1-A Alspaugh, SW SW NW 16-28-12, dry, T.D. 1,066 ft.

Fields

Chase, Rice County: McPherson Drlg. 1-D Patton, SW NW SE 9-19-9w, pumped 1,977 bbl., Arbuckle 3,250-52 ft.

Skelly 1 Link, E½ SW SE 19-19-9w, dry, T.D. 3,290 ft.

Couch, Cowley County: Ryan Consolidated 2 Victory Life, SW NW SE 12-30-5, abandoned location.

Frog Hollow, Cowley County: Leader Oil et al 2 Scott, NE NW NE 20-32-5, pumped and flowed 50 bbl., Bartlesville 3,030-34 ft.

Hewitt, Norton County: Helmerich & Payne et al 3 Hewitt, NE NE 11-4-21w, dry, T.D. 3,436 ft.

Lake City, Barber County: Pryor & Lockhart 1-C Gant, C SE 7-31-13w, 2,000,000 cu. ft. gas, Viola 4,425-32 ft., T.D. 4,656 ft., old T.D. 4,656 ft.

Patterson, Kearny County: Stanolind 1 Niblock, E½ NE NE, dry, T.D. 4,945 ft.

Peace Creek, Reno County: Magnolia 5 Yust, SW NW SW 15-23-10w, flowed 21 bbl. an hr. through choke, Viola 3,759-75 ft., acid.

Raymond, Rice County: Vickers Pet. 3-A Bayer, N½ NE NW 20-20-10w, pumped 19 bbl., Arbuckle 3,308-14 ft.

Rempel, Marion County: Western Pipe & Supply 1-A Rempel, C N½ N½ SW 5-21-4, dry, T.D. 2,525 ft.

Shutts, Ellis County: Lario Oil & Gas 12 Marshall, E½ SW SW 31-11-17w, abandoned location.

Trapp, Russell County: Coralena Oil 3 Seliens, C N½ N½ SE 17-15-13w, abandoned location.

Westhusin, Rooks County: Atlantic 2 McClay, C N½ N½ SW 12-9-17w, pumped 1,137 bbl., Lansing 3,306-12 ft., T.D. 3,313 ft., old T.D. 3,238 ft.

Cooperative 2 McClay, N½ SE SW 12-9-17w, pumped 267 bbl., Lansing 3,207-14 ft., 3,223-25 ft., T.D. 3,530 ft.

Winterschied, Woodson County: Guy Harper 11-A Figge, SW SW NE 28-23-14, pumped 5 bbl., Mississippi lime 1,651-61 ft.

Youngemeyer, Elk County: L. C. Collins et al 1 Porter ranch, SE SW SW 24-28-8, pumped 50 bbl., Arbuckle 2,926-34 ft.

NEBRASKA

ST. JOSEPH, Mo.—Ike W. Taylor of Centralia, Ill., spudded 1 Zentner in the Barada pool of Richardson County, Nebraska, the past week. He is drilling on a 120-acre farmout from Magnolia Petroleum Co. and plans two more wells on the lease. Thus far only Skelly Oil Co. has production in the Barada pool, that company having 12 wells.

Skelly's most interesting operation is about ¾ mile east of the Dawson pool in Richardson County. Skelly is the first major company to try the Dawson area. Power Oil Co. has a test shut down in that pool on top of Viola lime.

Very little work has been done in recent days about the Forest City basin because of mud.

NEBRASKA COMPLETIONS

Richardson County

Falls City pool: Towle & Isaacks 1 Sibbernsen, SW SW SE 17-1n-16e, pumping 2,544 ft., Hunton 2,273 ft., T.D. 2,320 ft.

Gage County: Bee Dee Oil 1 Bankers Life, NW NW SW 16-3-5, dry, T.D. 810 ft.

MISSOURI COMPLETIONS

Ray County

Chase et al 1 Chase, SW SW SW 26-52n-26w, dry at 325 ft.

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LOUISIANA GULF COAST

Tepetate Outpost Attempts Blowout From Deep Sand

By F. L. SINGLETON

NEW ORLEANS, La. — An attempted blowout has halted drilling operations at Vincent & Welch 1 Ardoin, an outpost test in the Tepetate field, Acadia Parish. The well is reported to have encountered gas sand with a salty taste at approximately 9,250 ft., where excessive gas pressures stuck the drill stem and the progress of the well will probably be delayed several days. The well is located in 19-7s-2w, and it is the first operation to be started in the area within the past several months.

In the same parish, and located on the Estherwood prospect, Continental and Sun Oil Co. 1 Homeseekers Development Co., in 10-10s-1w, is drilling in sand and shale below 10,600 ft., with broken sand showing gas at 10,500-10,600 ft.

Avoyelles Wildcat Reports Show

In Avoyelles Parish, 5½ miles northeast of the town of Marksville, Placid Oil Co. 1 Thompson-Katz Lumber Co., 4-2n-5e, was being watched with considerable interest as side-wall cores were being cut in the Wilcox. Total depth of the well is 7,801 ft., with the basal Vicksburg logged at 3,370 ft., Moody Branch at 3,700-15 ft., Sparta lime 4,450-97 ft., Cane River 5,220 ft., basal Cane River marl 5,510-15 ft., Wilcox at 5,540 ft., and the Ola zone at 5,785 ft. Side-wall cores are reported to have carried an odor of oil in the same section which was logged in Cockburn 1 Snowden, a dry hole located in 22-3n-5e.

Testing of Humble 1 Petit Anse, located on the southeast flank of the old Avery Island salt dome, Iberia Parish, gave little hope of production. Additional tests were made at 5,920-30 ft., and at 5,925-35 ft., and the well swabbed drilling mud with a slight show of gas.

On the Hayes prospect, Calcasieu Parish, Gulf 2 Citizens National Bank, was bottomed in sidetracked hole at 11,695 ft., and 7-in. casing was cemented at 11,578 ft. An electrical survey of the sidetracked hole showed 140 mv. porosity at 2 ohms resistivity at 11,574-11,608 ft., 160 mv. and 4 ohms at 11,617-56 ft., and 145 mv. and 1½ ohms at 11,661-68 ft. It is reported that the well will be drilled deeper before an attempt is made to test. This well has been in the process of drilling for several months, due to mechanical trouble caused by excessive gas pressures in the original hole. The first well drilled last year blew out, caught fire, and the hole was abandoned.

Deep Production Opened at Bayou Sale

Atlantic Refining Co. is reported to have opened production from a new and deeper sand in the Bayou Sale field, St. Mary Parish, but details were not available as to where the well was completed. Total depth of the well is below 12,000 ft., and casing is reported to have been cemented at that point.

On the Thornwell prospect, Jefferson Davis Parish, Cities Service Oil Co. recompleted 1 Lacassine Land Co., and the well is reported to be flowing at the rate of 100 bbl. of distillate per day through a 28/64-in. choke. Production is from perforated casing at 9,638-44 ft.

Commercial production was opened on the Bay De Chene salt dome, Jefferson Parish, when Texas 2-B La Fourche Basin Levee district flowed at rate of 421 bbl. of oil daily on a drill-stem test at 7,470-7,500 ft. Tubing pressure was 1,250 lb. Total depth of the well is 9,887 ft., and casing was cemented on bottom. Gas production was opened on this structure last year at 2,600-2,700 ft., and salt material was later found at 8,680 ft.

LOUISIANA GULF COAST COMPLETIONS

Fields

Jennings, Acadia Parish: Stanolind 122 Crowley Oil & Mineral Co., 492 bbl., perf. casing 7,620-50 ft., T.D. 7,703 ft.

Golden Meadows, La Fourche Parish: Michael & Menas 1 Cheramie, 52 bbl., 10/64-in. choke, perf. 2,642-50 ft., T.D. 2,664 ft.

Lake Chicot, St. Martin Parish: Amerada 1 Schwing, 130 bbl. net oil plus 2 per cent salt water, 5/32-in. choke, perf. casing 10,340-44 ft., T.D. 11,620 ft.

Lewisburg, Acadia Parish: Stanolind 1 Richard, 82 bbl., 7/32-in. choke, perf. casing 10,161-74 ft., T.D. 10,252 ft.

Paradis, St. Charles Parish: Texas 19 Paradis, 535 bbl., 7/32-in. choke, perf. casing 10,392-10,405 ft., T.D. 10,490 ft.

Texas 22 Paradis, 464 bbl., 7/32-in. choke, perf. casing 10,352-78 ft., T.D. 10,400 ft.

Sorrento, Ascension Parish: Pan American 20 United Land Co., 60 bbl., 5/64-in. choke, perf. casing 4,083-87 ft., T.D. 4,522 ft.

Starks, Calcasieu Parish: W. T. Burton 5 Industrial Lumber Co., dry, T.D. 7,856 ft.

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NORTH LOUISIANA, ARKANSAS

Deepest Lisbon Test Plugs Back After Small Gas Show

SHREVEPORT, La. — Union Production Co. 1 McDonald unit, 13-21n-5w, Claiborne Parish, on a drill-stem test 11,872 ft. to 12,108 ft. with ⅝-in. choke top and bottom, showed some gas, recovered 7 joints sour condensate and 12 joints mud in 2 hours. The well gaged 400,000 cu. ft. of sour gas on a drill-stem test from 11,872 to 12,592 ft., ⅝-in. choke on bottom and 1-in. choke on top, maximum pressure 100 lb. With total depth of 12,592 ft., the operators plugged back to 11,725 ft.; perforated casing from 9,562 to 9,582 ft. with 80 shots, and are now arranging to test. The same operator's B-1 Meadows, 13-21n-5w, is now drilling at 6,088 ft.

Louisiana Wildcats

Delaney & Crow 1 R. E. Wheless, SW NE 20-18n-12w, Bossier Parish, is drilling at 4,218 ft. In Caldwell Parish, Navarro Oil 1 Louisiana Central, SE SW 6-11n-3e, topped Wilcox at 1,580 ft. and is reported drilling at 3,185 ft. Atlantic Refining Co. 1 Catahoula Lake, SE NW 27-7n-4e, La Salle Parish, ran Schlumberger at 4,247 ft., cut 20 side-wall cores and had a show of oil at 4,163 ft. and 4,167 ft. The operator is now drilling at 5,380 ft. A Lincoln Parish wildcat, Carter Oil 1 Greene, SW NE 2-17n-3w, took five side-wall cores at 2,857 ft., 3,101 ft., 4,906 ft., 4,908 ft., and 5,856 ft., with no shows, and is now awaiting orders.

George H. Echols 1 Goodpine, NE NE 13-13n-8w, Natchitoches Parish, was reported drilling at 2,430 ft.; and in the same parish H. L. Hunt F-23 Goodpine, SW NW 12-13n-7w, was reported drilling at 4,627 ft.

In the Stephens field of Columbia County, Arkansas, Haynes B. Ownby 1 J. F. Smart, NW NE 13-15s-20w, with total depth at 3,428 ft., perforated casing at 3,415 to 3,419 ft. with 24 shots and tested salt water. The well was plugged back to 2,307 ft. and perforated from 2,083 to 2,087 ft. with 12 shots, and is now being tested.

Midway Activity

Barnsdall 2 Edgar S. Bond, SE NW 11-15s-24w, on a drill-stem test from 6,460 to 6,475 ft., had a slight blow of gas and 400 ft. of oil-cut mud. It is now flowing an estimated 4 bbl. of oil per hour through open tubing. Barnsdall 4 Edgar S. Bond, SE SW 11-15s-24w, set 5½-in. casing at 6,345 ft. and is waiting for cement. The same operator's 1 M. F. Creek, SW NE 10-15s-24w, spudded March 17, is running surface casing at 100 ft.; while 1 F. C. Roberts, NW SE 11-15s-24w, began March 15, set 16-in. casing at 94 ft. and is now drilling at 696 ft.

In the Mount Holly area, Atlantic Refining Co. A-1 Hughes, NE SE 9-17s-18w, shut in for storage for a week, was perforated at 7,228 to 7,230 ft. with eight shots and flowed 135 bbl. of oil and 25 bbl. of salt water daily through a 10/64-in. tubing choke. Tubing pressure was 450 lb. and casing pressure 650 lb. The well is making 80 per cent salt water, and operators are planning to squeeze.

Concordia Wildcat Productive

California 1 Pan-American Life Insurance Co., 16-9n-10e, wildcat located near Ferriday in Concordia Parish, produced approximately 50 bbl. of oil daily through a ¼-in. choke from the Wilcox formation around 4,600 ft. It is not known whether the operators will officially complete this well during the coming week or drill ahead.

NORTH LOUISIANA COMPLETIONS

Wildcats

Avoyelles Parish: Placid Oil 1 Thompson & Katz, SW SW 4-2n-5e, elev. 53 ft., top Vicksburg 3,280 ft., Sparta 4,430 ft., Cane River 5,190 ft., Wilcox 5,533 ft., dry at 7,800 ft.

Caddo Parish: D. C. Richardson, Jr., 1 Tri-State Realty Co., NW NE 27-19n-14w, elev. 174 ft.; topped Arkadelphia 787 ft., Nacatoch 896 ft., Sparta 1,268 ft., Annona 1,479 ft.; base Annona 1,642 ft., top Tokio 1,983 ft., base Tokio 2,022 ft., top Paluxy 2,450 ft., dry at 2,756 ft.

Catahoula Parish: Sinclair-Prairie 3 Tensas Delta, NW SE 10-8n-5e, top Wilcox 3,028 ft., Midway 5,598 ft., dry at 6,028 ft.

Fields

Indian Bayou, La Salle Parish: Carter Oil Co. D-2 Tensas Delta, NW SE 25-6n-6e, dry at 5,792 ft.

Nebo, La Salle Parish: Caroline Hunt 1 Kaufman, SW SW 2-7n-3e, 107 bbl. oil, 3 bbl. water, 4,065 ft. H. L. Hunt F-86 Goodpine, SW SW 22-7n-3e, 176 bbl. oil, 9 bbl. water, 4,269 ft.

Little Creek, La Salle Parish: Placid Oil 1 Radford, SW SW 24-9n-1e, dry at 2,782 ft.

De Soto-Red River, Red River Parish: C. L. Archer 1 Cockerham, NE NE 16-13n-11w, dry at 1,595 ft.

ARKANSAS COMPLETIONS

Fields

Midway, Lafayette County: Barnsdall Oil Co. 1 C. Beck, NE NW 14-15s-24w, 442 bbl. oil, 6,439 ft.

West Central Texas Fields

(Continued from Page 253)

Fields

Dunigan, Taylor County: Dunigan Brothers 4 Hunter estate, Lot 13, south subd. of W. R. Wills Sur. 122, pumped 84 bbl., oil sand 2,359 ft., T.D. 2,364 ft.

Hightower, Eastland County: Michigan-Ranger Oil Co. 3-H Brashear, William Van Norma Sur., A-565, dry, gas sand 1,375-96 ft., T.D. 3,450 ft.

McCaulley, Fisher County: L. A. Long 1 D. M. Maberry, Sec. 56, H.T.&B. R.R. Sur., Blk. 1, dry, T.D. 4,156 ft.

Wimberly, Jones County: Butler & Horne 4 A. M. Wimberly-A, Lot 87, De Witt C.S.L. Sur. 126, pumped 176 bbl. oil and 20 per cent water in 20 hr., lime 2,435-39 ft., acid, T.D. 2,571 ft., P.B. 2,445 ft.

Bailey Balken 1 Jewel Dunigan, Lot 89, De Witt C.S.L. Sur. 126, flowed 150 bbl. natural in 14 hr., est. 200 bbl., saturated lime 2,320-29 ft., soft lime 2,331-42 ft., T.D. 2,342 ft.

EASTERN TEXAS FIELDS

Woodbine Test Announced West of Long Lake

By ROBERT INGRAM

DALLAS, Tex.—Almost immediately after Bert Fields and Topaz Oil Co. 1 May, southwest Flag Lake outpost, was reported dry in the Woodbine, Bobby Manziel of Tyler (Hawkins pool discoverer) announced plans for a Woodbine wildcat northwest of Long Lake. The new test, Manziel 1 Levine estate, 2,000 ft. from the east and north lines of a 700-acre tract in the M. Sanchez Survey, lies between Flag Lake and the Tri-Cities Rodessa Glen Rose lime oil pool and about 3 miles north and west of Malakoff.

Manziel will move in a rig from the Hawkins pool and plans to drill to 4,000 ft. He expects the Woodbine at between 3,600 and 3,800 ft.

The southwest outpost, in the Tarkington Survey, had been an attempt to link the Flag Lake and Bazette pools. The well went to 3,264 ft., having topped the Woodbine zone at 2,968 ft. The sand section was said to have come in low and showed water. Location was southwest of Flag Lake production and north across the Trinity River from Navarro County's Bazette pool.

Meantime, Texas 1 Brown, Eans Survey, a scheduled deep wildcat in the eastern part of the county, was going ahead at 2,451 ft. Report was that the company would drill the well "tight."

Kildare Development Expected

Texas Co. and Phillips Petroleum Co. were reported examining titles last week on their offset acreage to the recent discovery of the Kildare pool in southern Cass County by John Messenger et al. Both were expected to announce tests soon. C. C. Gilger 1 Grogan, Watson Survey, 1,300 ft. north of the opener, was waiting on permit, and no date had been set for pool hearing.

EAST TEXAS COMPLETIONS

Wildcats

Bowie County: W. B. Hinton et al 1 J. L. Lumpkin, Wesley Byers Sur., 2 mi. N of Dalby Springs, dry, Nacogdoches 920 ft., Pecan Gap 1,462 ft., Woodbine red shale 3,040 ft., Woodbine pebble 3,252 ft., Paluxy 3,922 ft., second Paluxy 4,100 ft., Georgetown lime 3,340 ft., Goodland 3,880 ft., T.D. 4,125 ft.

Fields

Bazzett area, Henderson County: Bert Fields and Topaz Oil 1 Alice May et al, J. P. Tarkington Sur., dry, Austin chalk 2,260 ft., T.D. 3,263 ft.

Hawkins, Wood County: Humble 7-D B. F. Allen, George Brewer Sur., pumped 42.75 bbl., Austin chalk 4,402 ft., Woodbine 4,604 ft., top first pay 4,662 ft., water level 4,848 ft., T.D. 4,922 ft.

Humble 8 G. W. Atkins, J. P. Mosely Sur., flowed 106.94 bbl. in 6 hr. through ¼-in. choke, Austin chalk 4,210-88 ft., Woodbine 4,525 ft., pay 4,572 ft., T.D. 4,865 ft.

Humble 6-B L. A. Bryan, Willis Parker Sur., flowed 143.45 bbl. in 18 hr. through ¼-in. choke, oil sand 4,485 ft., Austin chalk 4,222 ft., Woodbine 4,449 ft., T.D. 4,614 ft.

Humble 1-A E. W. Moore, J. Pollock Sur., flowed 305.67 bbl. in 18 hr. through ¼-in. choke, Austin chalk 3,938 ft., Woodbine 4,395 ft., T.D. 4,746 ft.

Humble 2-B W. S. Shamberger, J. McNulty Sur., flowed 265.4 bbl. in 18 hr. through ¼-in. choke, Austin chalk 4,383 ft., Woodbine 4,677 ft., T.D. 4,897 ft.

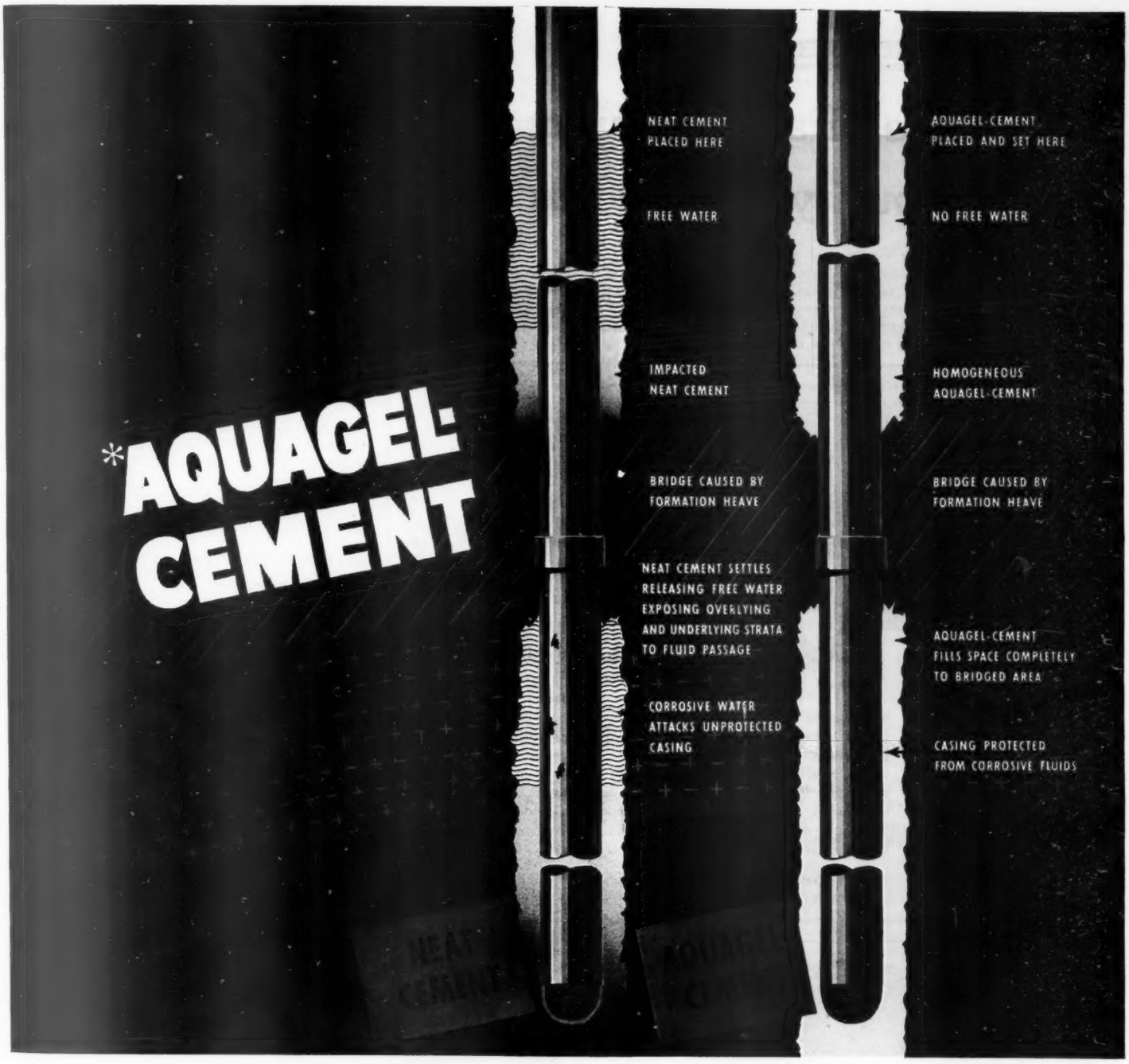
Humble 3-B E. M. Slaughter, M. A. Esparcia Sur., potential 52.72 bbl. through ⅛-in. choke, Austin chalk 4,084 ft., Woodbine 4,329 ft., oil sand 4,505-36 ft., T.D. 4,782 ft.

Humble 3 J. B. Smith, William Herrington Sur., flowed 97.36 bbl. in 6 hr. through ¼-in. choke, Austin chalk 4,370 ft., pay 4,790 ft., T.D. 4,975 ft.

S. H. Killingsworth 2 E. M. Green, J. P. Mosely Sur., pumped 85.48 bbl. in 6 hr., Austin chalk 4,598 ft., Woodbine 4,860 ft., pay 4,860 ft., T.D. 4,897 ft.

Long Lake, Leon County: F. H. E. Oil 3 Standard of Kansas, S. Sanches Sur. 7, flowed 65.76 bbl. through 5/64-in. choke, gas-oil ratio 260:1, T.D. 5,283 ft.

Wortham, Freestone County: J. B. Daniels 2 Calme, R. B. Longbotham Sur., potential 56 bbl. oil net plus 85 per cent water, sand 2,964 ft., T.D. 2,966 ft.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BRIDGE CAUSED BY FORMATION HEAVE
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In both wells a heaving stratum has sloughed, forming a bridge around each casing during, or shortly after, running of the cement. Note that the neat cement has settled below the bridge, thus exposing the casing to the injurious attack of corrosive salt water and allowing the harmful transfer of fluids between adjacent strata. The AQUAGEL-Cement, on the other hand, remains in place substantially as set, protects the casing from further sloughing, from the corrosive effects of salt water and prevents the transfer of fluids between adjacent strata.

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**AQUAGEL-Cement, or gel cement as it is commonly known, is any Portland or oil well cement to which has been admixed a small amount of AQUAGEL to keep it from releasing free water or allowing settling, and at the same time to impart to it sufficient gelling properties at the water-cement ratio at which it is to be used.*

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INDIANA, OHIO, KENTUCKY

Aux Vases Pay Is Found in Posey County Wildcat

EVANSVILLE, Ind.—Casing was set last week at Paul Rossi 1 E. Mauzy, a wildcat test about 4 miles east of Mount Vernon in the NE NW NW 8-7s-12w, Posey County, after excellent saturation in the Aux Vases sand was found. The Aux Vases was topped at 2,609 ft. and total depth of the well is 2,619 ft. There was between 5 and 6 ft. of saturation. Before casing was set, oil rose 1,000 ft. in the hole during a 25-minute drill-stem test of the sand.

No. 1 Mauzy is the third successive Posey County wildcat to find saturation in the past few days.

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Sinclair-Wyoming 1 Dora Nash was completed as a McClosky pool opener last week after pumping 240 bbl. of oil in 24 hours. It is in the SW SW NE 32-7s-14w. Carter Oil Co. has just completed another pool opening well west of Mount Vernon, 1 Baker, SW NW 9-7s-14w. No. 1 Baker made 250 bbl. of oil in 24 hours following a 3,000-gal. acid treatment in the McClosky at a total depth of 2,963 ft.

Warrick County Wildcat Produces From McClosky

Forrest et al 1 Frank Sutton, SW SE SW 35-4s-6w, Warrick County, about ¼ mile northwest of the old Gentryville field, is showing for a producer from the McClosky lime. Saturation was topped with cable tools at 1,165 ft. and total depth is 1,172 ft. Oil rose 400 ft. in the hole within 30 minutes and later began slopping over the top of the hole. Before a production test can be made it will be necessary to set an 1,100-ft. oil string which must be pulled from another well. As a result it may be several days before a production test can be made. In the meantime, storage tanks are being built.

There is some McClosky production in the Gentryville field but most of the wells there produce from the Jett sand (Pennsylvanian).

Knox County Test May Extend Hazleton Field

Sinclair-Wyoming 1 J. Brevoort, SW SW SE 15-2n-11w, a Knox County wildcat a short distance northeast of St. Francesville, is testing McClosky saturation at 1,840-43 ft., following a 3,000-gal. acid treatment. The well appeared capable of producing about 50 bbl. a day. Total depth of the test is 1,936 ft.

OHIO

ZANESVILLE, Ohio. — Successful completions in the Ohio fields reached a low mark during the past week with five small gassers and nine dry holes reported. New work begun during the week consists of six Clinton tests in the central fields and four in the shallow pools.

OHIO COMPLETIONS

Athens County, Carthage Township: C. W. Nuzum 1 Bailes, Sec. 34, 500,000 cu. ft. gas, M-800 sand, T.D. 1,134 ft. (old gas well drilled deeper.)

Cuyahoga County, Independence Township: Hayjack et al 1 B. Schramm, Lot 23, dry, Clinton, T.D. 3,100 ft.

Fairfield County, Rush Creek Township: City Natural 1 C. R. Crooks, Sec. 6, dry, Clinton, T.D. 2,469 ft.

Licking County, Madison Township: C. A. Davis 1 Paul Kennedy, second quarter, 100,000 cu. ft. gas, Clinton 2,443-76 ft., T.D. 2,487 ft.

Lorain County, Columbia Township: Ohio Fuel 1 Kundtz Properties, Lot 83, 200,000 cu. ft. gas, shot Clinton, T.D. 2,637 ft.

Medina County, Hinckley Township: Belmont Quadrangle 1 Metropolitan Park Board, Lot 72, dry, Clinton, T.D. 3,643 ft.

Monroe County, Malaga Township: Barnesville Dev. C. 2 Fred Peters, Sec. 22, 40,000 cu. ft. gas, Berea, T.D. 2,045 ft., shot.

Wayne Township: Kovert et al 1 H. Bach, Sec. 21, 60,000 cu. ft. gas, Berea, T.D. 1,752 ft.

Highman et al 3 G. B. Drake, Sec. 14, 20,000 cu. ft. gas, plugged, lime sand, T.D. 1,341 ft.

Noble County, Olive Township: Bob Sprague 2 J. H. Wells, dry, T.D. 209 ft.

Perry County, Coal Township: Preston Oil 207 Sunday Creek Coal Co., Sec. 25, dry, Clinton 3,403-3,432 ft., T.D. 3,438 ft.

C. Z. Ruth 22 North West Coal Co., Sec. 22, dry, Berea, T.D. 1,118 ft.

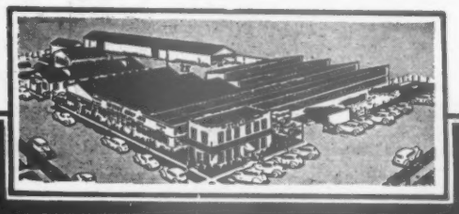
Seneca County, Liberty Township: Sage, Poe Elliott 1 Dayton H. Conner, SW NE Sec. 28, dry, Trenton (top) 1,957 ft., Knox dolomite 1,962-80 ft., Blue Lick water 1,970-75 ft., T.D. 1,980 ft.

Washington County, Aurelius Township: Dickey Oil Co. 1 C. G. Dutton, Sec. 22, dry, Berea, T.D. 1,548 ft.

EASTERN KENTUCKY

ASHLAND, Ky.—Two gas wells were completed in eastern Kentucky this week and acidizing of a third brought it into the good production class. One dry hole was reported and other operations remained on the same general level with a new location listed.

(Continued on Page 273)



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OKLAHOMA FIELD REPORT

Edge Wells Make Good Show In Week of Little Activity

By CARL HOOT

ALTHOUGH completions for the week were of no consequence except for a 25,000,000-cu. ft. gasser in the Cement pool of Caddo County and a 254-bbl. addition to the Hotulke pool of Pottawatomie County, wildcat activity was picking up, with good shows of oil at several tests.

Okfuskee County

At the northeast edge of the Okemah pool, Portable Drilling et al 1 Engleman, NW NE NW 30-11-10, flowed 62½ bbl. of oil and 16 bbl. of water a day through casing, with an estimated 500,000 cu. ft. of gas. Total depth is 3,895 ft. Operators will plug back in an attempt to shut off water.

British American 1 Dodson, SW NW NW 31-12-10, had total depth at 3,778 ft. and was running 5½-in. casing to test a show of oil in the Hunton at 3,776 ft.

Doak & Hughes 1 Kensley, NW SE NW 21-13-9, swabbed 25 bbl. of oil from the Dutcher sand at 3,180 ft. and was testing. Total depth is 3,190 ft.

Payne County

W. H. Riddle 1 King, NW NW NE 6-17-5, was drilled to 3,660 ft., plugged back to 3,650 ft., shot and swabbed 18 bbl. of oil and 18 bbl. of water. After another shot at 3,626-50 ft. the well was cleaned out and swabbed 2 bbl. of oil an hour. If successful, the well will extend the March field about 1 mile west.

Pottawatomie County

Southeast of the old Tecumseh pool, Cities Service and Atlantic 1 Fort Cobb, SW NE NE 4-8-3, flowed 366 bbl. of oil in 6 hours through ¼-in. choke on tubing and was shut in for connections. Total depth was 5,465 ft. The well was drilled to 5,465 ft. but was plugged back after the Willcox was found dry. A second plug back was to the Hunton at 5,186 ft. which was perforated from 4,759-87 ft.

At the north end of the Maud area, Continental 1 Hallum, SW NW NE 6-8-5, found the Hunton at 4,107 ft., set 6-in. at 4,102 ft. and after drilling plug and bailing down, 575 ft. of oil rose in the hole in 8 hours. Total depth is 4,120 ft. Operators are preparing to acidize.

OKLAHOMA COMPLETIONS

Wildcats

Cotton County: H. P. McCoughy 1 Kinnard, NE cor. 26-5s-12w, abandoned location.

Lincoln County: R. L. Kemp 1 Rhodes, SW SW SE 28-17-6, dry, T.D. 3,660 ft., Oswego 2,700 ft., Prue 2,767 ft., Mississippi lime 3,351 ft., Woodford 3,460 ft., Sylvan 3,495 ft., Viola 3,527 ft., Wilcox 3,596-3,660 ft.

(Continued on Page 272)

DAILY AVERAGE PRODUCTION

LEADING OKLAHOMA FIELDS

	Mar. 21	Mar. 14
Allen	3,700	3,850
Apache	3,700	3,750
Billings	5,750	5,700
Burbank	7,750	7,800
South Burbank	7,250	7,450
Balance Osage	16,800	17,700
Blackwell district	3,050	3,050
Bristow-Slick	6,150	6,275
Cement	11,200	11,450
Coyle	3,750	4,000
Crescent	1,300	1,325
East Cromwell	5,775	6,250
Cromwell	2,750	2,825
Cumberland	6,800	6,950
Cushing-Shamrock	8,025	8,100
Dill	1,650	1,775
Duncan	3,150	3,200
Edmond	2,900	2,950
Fish	2,975	3,150
Fitts	9,200	9,450
Jesse	1,800	1,800
Graham-Fox	1,825	1,850
Guthrie	3,450	3,500
Healdton	8,000	8,025
Hewitt	11,100	10,850
Keokuk	2,500	2,550
Konawa	950	975
Lucien	4,600	4,650
Moore	700	650
Northeastern counties	16,250	16,550
Oklahoma City	74,850	73,500
Olympic	1,425	1,400
Ramsey	4,500	4,650
Sasakwa	1,000	1,050
Sholem-Alechem	2,425	2,400
Stroud	700	725
Seminole district:		
Bowlegs	5,025	5,000
Carr City	1,925	1,950
Dora	1,100	1,125
Earlsboro	3,100	3,150
East Earlsboro	1,500	1,500
South Earlsboro	1,100	1,150
Little River	5,325	5,500
East Little River	525	525
Mission	1,025	1,050
Seminole	5,375	5,500
East Seminole	750	800
Searight	1,550	1,600
Total Seminole	28,300	28,850
St. Louis-Pearson	14,600	14,750
Tatums-Tussy	4,700	4,725
Wewoka	1,425	1,450
Yale-Jennings	3,300	3,250
Total Oklahoma	390,350	396,250

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Among the Drilling

WARREN & BRADSHAW, Tulsa, received contract last week to drill Texas Co. 1 Oxley, NE SE SE, 35-6n-12w, northeast of the Apache field in Caddo County, Oklahoma.

FALCON-SEABOARD Drilling Co., Tulsa, has started operations on contract for Waite Phillips 1 Sargent, C NW NW, 18-30-1e, Sumner County, Kansas.

H. G. MARSHALL has contract for the Wilcox sand on the Herman Hurst 1 Womack, in Pottawatomie County, Oklahoma, in SW NE NE of 32-9n-3e, southeast of Tecumseh, which was drilling below surface pipe.

COMMERCIAL Drilling Co. has the contract for Fred T. Haddock 1 Phillips, Seminole County, Oklahoma, in SW NW SE of 8-9n-6e, east of the Earlsboro area, which was drilling below 3,600 ft.

M. BRADHAM, drilling contractor of El Dorado, Ark., has the contract for the Hygrade Oil Co. 1 Ford, in Lafayette County, Arkansas, C NW NW of 32-14-23. This is the first wildcat to test formations north of the Graben fault since Barnsdall Oil Co. brought in the discovery well at Midway, about 2½ miles to the south.

FALCON-SEABOARD Drilling Co., Wichita, Kans., 1 Martz, Barton County, Kansas, SE NW of 25-16-15w, 6 miles northeast of the Pospishel (Arbuckle) pool, topped the Topeka lime at 2,990 ft. and was drilling below 3,160 ft., looking for the Lansing lime.

HOLLANDSWORTH Drilling Co., Longview, Tex., has the contract for 1 Bonnie Carter, William Whitaker Survey, Wood County, Texas, northwest of Rhonesboro and 660 ft. west of the Wood-Upshur boundary line, 6½ miles northeast of Hawkins field. Materials are being moved in. F. R. Jackson, B. B. Orr and Roy L. Fisher staked the well.

ROWAN Drilling Co., Fort Worth, Tex., is moving in rotary rig for immediate starting of the company's 1 Field, Section 46-D-Gibson, planned 5,500-ft. wildcat in the northwest corner of Yoakum County, Texas. It was staked several weeks ago.

J. C. HUNTER, Abilene, Tex., has taken contract to drill W. F. Morgan 1 J. S. Craft, a wildcat operation in Coke County, 3 miles southwest of Blackwell, Tex., near the Coke-Nolan county line. It will be a diagonal southwest offset to the old Mid-Kansas 1 W. E. Lackey, which in April 1929 struck 40-gravity oil at 3,755-56 ft. but failed to make a commercial well in drilling to 4,255 ft.

HOLLANDSWORTH Drilling Co., Longview, Tex., has purchased three leases in Hutchinson County, Texas. The contracting and operating firm acquired the Christian lease from William Murphy and the Groves and Herring leases from Cy Reiger.

HELMERICH & PAYNE, Inc., Tulsa, spudded a new well in the Eunice field, Lea County, New Mexico. The new operation is Gulf Oil Corp. 11 W. A. Ramsey, NE cor. 35-21s-36e.

COLUMBIA Oil & Gas Co., Mount Pleasant, Mich., has taken contract to drill Chapman Oil Co. 1 Swift-Campbell-Dales, SW NW NE 2-10n-7w, Montcalm County, Michigan.

W. L. GOLDSTON, Houston, Tex., marked up a slight extension to the Needville field, Fort Bend County, Texas, with the completion of 1 Lehman, which is testing in the discovery sand at 5,100 ft.

GLENN H. McCARTHY, Houston, Tex., opened a new sand in the Stowell field, in Jefferson County, Texas, with the completion of his 1 E. A. Englin as a gas-distillate producer in sand at 8,400 ft., some 400 ft. higher than the discovery pay. In the meantime, 1 Munson, located in the Bailey's Prairie area, Brazoria County, Texas, is being recompleted in an attempt to lower the gas-oil ratio. This well is being tested in sand below 11,000 ft. In the Magnolia area, Montgomery County, Texas, 1 South Texas Development Co. was spudded during the week.

BREWSTER-BARTLE Drilling Co., Houston, Tex., opened a new Wilcox sand discovery for the Southwest Texas district with the completion of Adams Oil & Gas Co. 1 Berck, located 3 miles east of the town of Yorktown in De Witt County. Total depth of the well is 9,150 ft. It is flowing gas distillate from perforated casing opposite sand at 7,200 ft.

HENDERSON COQUAT, of Three Rivers, Tex., is moving in a rotary to Live Oak County, Texas, for a 5,000-ft. Yegua sand test located 1 mile west of the town of Mikeska. The well is 1 E. L. Riser, located in the Ed Ramirez Survey, and is being drilled jointly with George Buescher.

O. W. KILLAM, San Antonio, Tex., opened a new gas field for the Laredo district by the showing of 2 Puig, 2½ miles south of the McLean field, Webb County, Texas. While the well is drilling ahead, drill-stem testing at 2,208-43 ft. tested an estimated 2,500,000 cu. ft. of gas. The well is being drilled jointly with the Midstates Oil Co. In the same area, the contractor announced location for 1. A. M. Bruni in Block 2, of the Albercas grant.

POHLAND Drilling Co., Midland, Tex., was rigging up spudder at Humble Oil & Refining 1 Clara Couch, ½ mile southeast of the Fort Lancaster discovery in Section 37, Block GG, H.E.&W.T. Survey, Crockett County, Texas. The same contractor was drilling at 1,355 ft. at Humble 1-C J. W. Owens, in Section 17, same area, and had set 5½-in. casing at Humble 1-B Owens, in Section 8.

HARBAR Drilling Co., Wichita, Kans., received contract from Sinclair Prairie Oil Co. for a wildcat test in Frontier County, Nebraska, 14 miles north of the town of McCook. The well is the 1 Brown. Location is 660 ft. from the south and west lines of the SW¼ 21-5n-29w.

GROOVER & ROSE, Albany, Tex., have the contract for Kittery Oil Co. et al 1 J. H. Elliott, a 3,000-ft. semi-wildcat in Shackelford County, Texas, 660 ft. from the north and east lines of SW Section 9. This well is 1,320 ft. north of R. H. Roark 1-B Elliott, another well for which Groover & Rose have the contract. The same firm is also drilling (at 1,779 ft.) at Roark 1-C J. H. Elliott, 660 ft. from the north and west lines of SE Section 9, L.A.L. Survey.

NELSON Drilling Co., Hutchinson, Kans., has moved a slim-hole rig to location for 2 Smyers, NE SE SW 36-19-6w, ¼ mile south of the discovery well of the new Smyers field.

BALDRIDGE & KING, McAllen, Tex., were credited last week with making notably fast time in skidding a rig and derrick from one location to another almost 3 miles away. The company skidded the rig from a Sun Oil Co. well in the Yturria field, Starr County, Texas, to a wildcat lo-

Contractors

cation, Sun 1-A Frost, in about 3 days. Before the skid job was started, a 60-ft.-wide road was cleared between the two locations. A truck and tractor were used in rolling the derrick along on sections of pipe laid on planks.

EDWIN M. JONES, San Antonio, Tex., is moving a light rotary about 5 miles east of Randado, Jim Hogg County, Texas, where location for 1 Hellen was recently made in Survey 50. Contract depth is 3,500 ft.

SIEMONEIT Drilling Co., Fort Worth, Tex., was moving in rotary rig last week to start Henry Roach 1 University, Section 10, Block 10, University lands, outpost nearly 2 miles south of production in the West Fuhrman pool, Andrews County, West Texas.

ROWAN Drilling Co., Fort Worth, Tex., has the contract for M. H. Reed 1-A University, ¾ mile east of Amerada 1-RA University, discovery well of the Barnhart Ordovician (9,000-ft.) field in Reagan County, West Texas. Rowan drilled the discovery and several other tests in the area. Reed, an Austin, Tex., operator, is scheduled to drill four tests in the field of which 1-A University is the first.

NOBLE Drilling Co., Tulsa, has a contract to drill Stanolind Oil & Gas Co. 1 J. W. Hopping in the east central part of Lamb County, ½ mile east of the town of Fieldton, in far northern West Texas. The well is considerably north of production and borders on the Panhandle counties.

E. C. LAWSON, Tulsa, has a contract to drill 1 M. A. Smith, a wildcat carried in his own name for a syndicate, in Haskell County, West Central Texas, J. McCass Survey 51, A-95, southeast of the Lawson 1 Rose, producer.

KIRWOOD & MORGAN, San Antonio, Tex., received contract for the first of two wildcat tests to be drilled 5 miles north of the Carolina field, Webb County, Texas, for W. Earl Rowe and Rodney De Lange, San Antonio operators. Location for the first test is near the center of Section 203½.

Eastern Contractors Planning Association

DRILLING contractors in the eastern fields, including western Pennsylvania and southwestern New York, are planning organization of an association to promote and defend interests of the membership.

Spur to organization plans has been the Treasury's proposal to insist upon capitalization of intangible drilling costs, eliminating the practice now widely in effect of charging the items to deductible expenses. This legislation, it is feared, would go a long way towards eliminating drilling contractors.

Several committee meetings have been held at Bradford, Pa., it is understood, to draw up bylaws for the proposed organization.

A general open meeting, to which all those interested will be invited, is expected to be called at Bradford in the near future.

Ike Hull, drilling superintendent; Joe Moore, office manager, and Harry Russell, head driller, all of the Zephyr Drilling Co., Tulsa, on location in the Bristow area of Creek County, Oklahoma. The company has tools in Illinois, Indiana, Kansas, and Oklahoma

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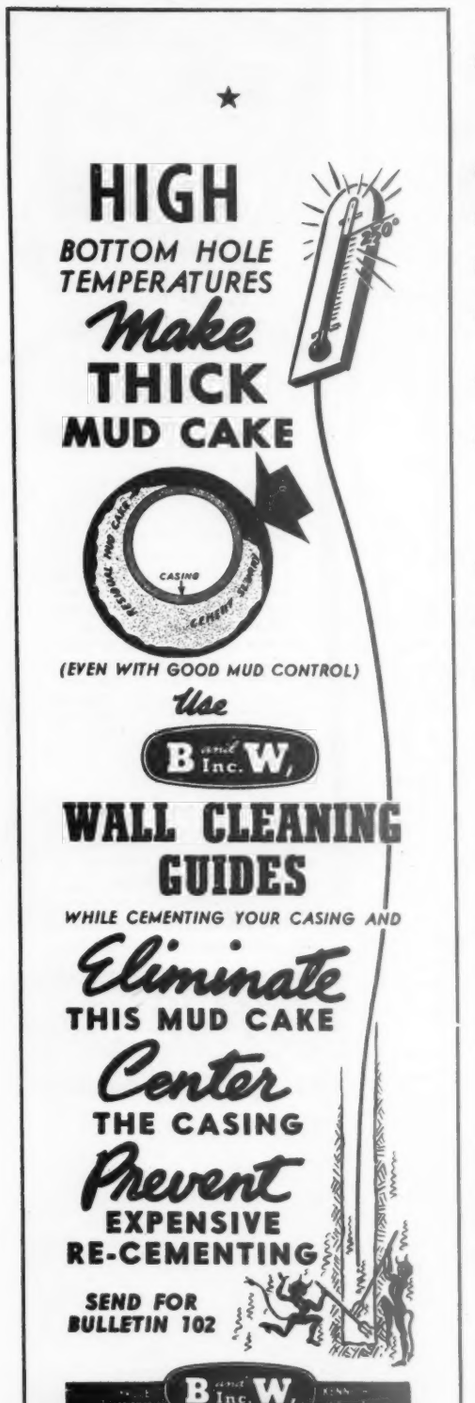


Illinois Fields

(Continued from Page 264)

Bible Grove, Clay County: Pure 1-A Grahn, NE NW 8-5n-7e, dry at 2,889 ft., Menard 2,119 ft., Tar Springs 2,251 ft., Glen Dean 2,328 ft., Barlow 2,481 ft., Cypress 2,500 ft., slight show oil, Benoist 2,660 ft., Aux Vases 2,727 ft., slight show oil, Ste. Genevieve 2,780 ft., Rosiclare 2,794 ft., Fredonia 2,818 ft.

Centralia, Marion County: A. L. Peterson et al 1 Timmons, NE SW SE SW 19-1n-1e, pumped 10 bbl., 50-qt. shot 735-75 ft., sand 732-78 ft., T.D. 780 ft.

Dale, Hamilton County: Shell 1 Dudley et al, SE NE SW 7-6s-7e, pumped 58 bbl., 10-qt. shot 2,913-20 ft., Benoist, old well P.B. from 3,038-2,947 ft.

Dundas, Jasper County: Pure 2 Pryor, E½ NW SE 7-5n-10e, flowed 261 bbl., 5,000 gal. acid, McClosky 2,827-33 ft., 2,848-53 ft., T.D. 2,865 ft.

East Centerville, White County: Magnolia 1 Jares Estate, SW SE NE 7-4s-10e, pumped 145 bbl., perf. 3,175-84 ft., 1,000 gal. acid, Levias 3,170-83 ft., T.D. 3,276 ft., P.B. 3,212 ft.

Johnsonville, Wayne County: Wiser 3-C Dickey, NW SW NE 3-1s-6e, flowed 650 bbl., perf. 3,169-77 ft., 3,181-85 ft., 2,500 gal. acid, McClosky 3,169-71 ft., 3,181-85 ft., T.D. 3,237 ft.

New Harmony, White County: Tide Water 15 Dennis, NW NW NW 33-4s-14w, pumped 143 bbl. oil and 21 bbl. water, 80-qt. shot 2,582-2,605 ft. in Cypress, old well deepened from 2,730-34 ft.

Tide Water 16 Dennis, SE SE SW 28-4s-14w, pumped 105 bbl. oil and 25 bbl. water, 80-qt. shot 2,712-35 ft., 30-qt. shot 2,584-93 ft., Cypress 2,574-96 ft., old well P.B. from 2,834-2,735 ft.

North Simms, Wayne County: S½ SE SW 17-1s-6e, pumped 243 bbl., 5,000 gal. acid, Rosiclare 3,152-57 ft., T.D. 3,248 ft., P.B. 3,178 ft.

Parkersburg, Richland County: Longhorn Oil 1 Ahlfield, W½ NW SE 21-2n-14w, dry at 3,198 ft., Glen Dean 2,525 ft., Golconda 2,616 ft., Barlow 2,698 ft., Renault 2,918 ft., Ste. Genevieve 3,054 ft.

Robinson, Crawford County: Ohio 28 Ducommen, SE SE NE 35-6n-13w, dry at 4,654 ft., base Pennsylvanian 1,318 ft., Salem 1,727 ft., Chattanooga 2,390 ft., Devonian 2,530 ft., Maquoketa 3,570 ft., Trenton 3,859 ft., Joachim 4,576 ft., St. Peter 4,650 ft.

Roland, White County: Trans-Tex 2 Baker, SE NW NW 14-7s-8e, location abandoned.

Carter 1 H. Edwards, NE NW SE 15-7s-8e, pumped 23 bbl. oil and 140 bbl. water, natural, Waltersburg sand 2,167 ft., T.D. 2,190 ft.

Rural Hill, Hamilton County: Magnolia 2 J. A. Hamilton, NE SE SW 24-6s-5e, flowed 125 bbl., natural, Aux Vases sand 3,101-12 ft., T.D. 3,112 ft.

Shell 4-B Crabtree, SE SW SW 13-6s-5e, pumped 294 bbl. oil and 10 bbl. water, old well P.B. 3,370-3,146 ft.

Salem, Marion County: Tide Water 6 Miller, NW NE NE 18-1n-2e, pumped 20 bbl. 500 gal. acid, old well worked over, T.D. 2,097 ft.

Tide Water 1 Miller, NE NE NE 18-1n-2e, pumped 20 bbl. in 18 hr., 10-qt. shot 1,911-18 ft., Aux Vases 1,909 ft., old well deepened from 1,879-1,922 ft.

Walpole, Hamilton County: Texas 1 Brown Comm., W½ SE NE 34-6s-6e, pumped 232 bbl., natural, Aux Vases sand 3,095-3,112 ft., T.D. 3,112 ft.

Oklahoma Fields

(Continued from Page 269)

Osage County: Cities Service 1 Osage, SW NE NE 35-25-10, dry, T.D. 2,180 ft., Oswego 1,380 ft., Bartlesville 1,755 ft., Mississippi lime 1,860 ft., Arbuckle 2,161 ft., will be used as water-disposal well.

Tillman County: Anderson-Prichard 1 Lock, N½ NW NW 28-2s-15w, dry, T.D. 4,510 ft., Arbuckle 4,336 ft.

Okfuskee County: Olson & Springer 1 Hardin, SW NW SE 35-13-9, dry, T.D. 4,027 ft., Bartlesville 2,675 ft., Booch 2,985 ft., Cromwell 3,300 ft., second Wilcox 4,015 ft.

Fields

Altus, Jackson County: Harwell-Hill 6 Guyrman, NE SW SW 14-1-20w, dry, T.D. 1,770 ft.

Cement, Caddo County: Ray Stephens 3 Wilhite, NE SW SE 28-6-10w, 25,000,000 cu. ft. gas, 5,330-60 ft., T.D. 6,221 ft., R.P. 1,780 lb.

Ohio Oil 10 Wagner, SE NE SW 12-5-9w, dry, T.D. 163 ft., abandoned because of spacing rule.

Comanche, Stephens County: George Pace 1 Dilley, SE cor. 22-2s-7w, dry, T.D. 2,158 ft.

Creek County: Tibbens 6 Wilson, S½ SW SE 18-14-9, pumped 38 bbl., Prue 2,372-2,408 ft., T.D. 2,412 ft.

Empire, Stephens County: J. E. Jackson 1-B Taliaferro, SE NW SW 27-1s-8w, dry, T.D. 1,980 ft.

H. G. Gay et al 1-B Bullard, C N½ NE 34-1s-8w, dry, T.D. 2,305 ft.

Grady, Knox County: Raizen Bros. 3 Nation, NW NW SE 34-3-5w, dry, T.D. 1,943 ft., old T.D. 1,436 ft.

Hotulke, Pottawatomie County: Sunray et al 1 Gilbreath, SW cor. 23-9-4, pumped 254 bbl., Wilcox 4,427-31 ft., old T.D. 4,551 ft., P.B. 4,470 ft.

Hobart, Kiowa County: Shell 2 Watkins, SW NE NW 2-7-17w, dry, T.D. 1,217 ft.

Loco, Stephens County: Elm Oil 1 Selly, SE NE NE 7-3s-5w, dry, T.D. 500 ft.

Elm Oil 1 Massey, SW NW NW 8-3s-5w, dry, T.D. 503 ft.

Okfuskee County: Deep Rock 1-A Chastain, SE NW SW 7-11-8, dry, T.D. 4,490 ft.

Oklahoma City, Oklahoma County: British American 1 Sheffield, SW NE NW 15-11-3w, dry, T.D. 6,486 ft.

Okmulgee County: Rounsaville 1 Davis, SW NE NE 31-12-12, pumped 12 bbl., sand 1,185-1,217 ft., 1,495-1,550 ft., T.D. 1,930 ft.

Osage, Osage County: Cities Service 481 Osage, SW NW SW 13-25-10, dry, T.D. 2,157 ft.

St. Louis, Pottawatomie County: Gulf 2 Rosewood, S½ NW NE 26-7-4, pumped 22 bbl., dolomite 4,046 ft., old T.D. 4,242 ft., P.B. 4,219 ft.

Seminole County: Kerlyn 1 Washington, NW SW NW 8-8-7, abandoned location.

Miscellaneous

Coal County: Ramsey Pet. 1 Harinek, NW NW 26-2-9, dry, T.D. 1,760 ft.

Creek County: Freeland Bros. 2 Bell, SE NW SW 16-17-8, old T.D. 3,506 ft., C.O. to 2,840 ft., pumped 5 bbl.

Sinclair Prairie 41 Berryhill, NW SW SE 16-17-12, dry, T.D. 1,588 ft., repressure well.

Big Four 6 McIntosh, N½ NE NW 26-18-7, 600,000 cu. ft. gas, limy sand 2,005-19 ft., T.D. 2,078 ft., old T.D. 860 ft.

Okmulgee County: Minshall & Lowery 3 Lewis, NW SW NW 33-16-11, pumped 35 bbl., Glenn sand 1,990-2,052 ft.

Minshall & Lowery 1 Thompson, NW SW NW 33-16-11, pumped 35 bbl., Bartlesville 2,038 ft., T.D. 2,052 ft.

Osage County: O. G. Oliphant 5 Osage, NE NE SW 34-29-11, pumped 2 bbl. and 200,000 cu. ft. gas, sand 877-934 ft., T.D. 938 ft.

Arkansas Smackover Lime Pools Have Large Sour-Gas Reserves

(Continued from Page 250)

the field indicates the presence of a water drive. The abandoned producer, Carter 1 Cornelius unit, NE 30-17-24, was plugged back and recompleted in the Cotton Valley, being the only well in the field producing from that formation.

The pay is found from 8,750 to 9,070 ft. and has an average thickness of 105 ft. With a porosity of 17 per cent and permeability of 500 millidarcys, it is estimated that the recoverable reserves are 225,000,000,000 cu. ft. of gas and 18,000,000 bbl. of oil.

Dorcheat and Macedonia

The Dorcheat field in Township 18s, Range 22w, is believed to occupy about 2,000 acres. It has a definite oil horizon and the gas-oil ratio is smaller than at McKamie. Reserves in Dorcheat are estimated to be 70,200,000,000 cu. ft. of gas with 4,050,000 bbl. of distillate and 17,000,000 bbl. of oil. The field was discovered at what is now the west end and production was extended eastward, leaving the east and south sections of the field still undeveloped. Spacing has been on a 40-acre pattern but operators have agreed to drill the remaining wells on 80-acre rectangles with the long axis parallel to the trend of the structure.

Macedonia is the newest field in the Smackover belt south of the fault, having been discovered in July 1941. It is still only partially developed and is believed to cover about 2,000 acres. Estimated reserves are slightly larger than at Dorcheat, being 101,700,000,000 cu. ft. of gas and 7,200,000 bbl. of distillate. There is no known oil reservoir below the gas.

The sulfur content of the gas in the Macedonia-Dorcheat districts is smaller than at McKamie, being about 2,000 grains per 1,000 cu. ft.

The Smackover lime pools are believed to be under a water drive, although pressure relations are not definite in many of them. Macedonia and McKamie have not been sufficiently depleted to show any active water drive and Dorcheat, which has suffered a pressure drop of considerable proportions has been fairly rapidly depleted, possibly faster than water encroachment could have taken place.

The bottom-hole pressure at McKamie was originally 4,365 lb. and dropped to 4,224 lb. when the field was shut in. During the shut-in period, it rose some 25 lb. Withdrawals at McKamie have totaled 2.41 per cent of the estimated void space and pressure has declined 2.82 per cent, indicating that the differential is not sufficient to bring about much water drive. In Magnolia, the production has amounted to 5.45 per cent of the voids and pressure has dropped 9.75 per cent. Buckner

also shows a relatively high pressure drop with production of 8.1 per cent and pressure drop of 18.75 per cent. At Schuler, Atlanta and Village, the reverse is true as the three fields show production of 19.68, 11.71 and 32.15 per cent respectively compared with pressure drops of 5.35, 6.3 and 2.4 lb.

Permian Basin, Panhandle Fields

(Continued from Page 259)

In West Eunice, Wilson Oil Co. 8 State, 990 ft. from the south line and 2,310 ft. from the east line of 13-21s-34e, flowed 1,250 bbl. natural in 6 hours through open 7-in. casing. The big well is producing from only 8 ft. of saturation in a lime horizon. The saturated zone was topped at 3,752 ft. and hole is bottomed at 3,760 ft. As an indirect west offset Wilson has staked 10 State in SE SW 13-21s-34e.

Eddy County's prospective pool opener is Neil H. Wills 1 Wills, NW SW 13-20s-28e. No. 1 Wills encountered saturation in the Yates sand at 786-93 ft., the total depth, and filled at an hourly rate of 1 bbl. Operators have cemented a string of 7-in. casing near the top of the oil sand.

SOUTHEAST NEW MEXICO COMPLETIONS

Lea County

Wildcat: Prexy E. Wilson 1 Saunders, SE SE 11-25-35, dry, T.D. 5,148 ft., sand, Delaware lime 4,955-70 ft., Delaware sand 5,140 ft.

Arrowhead: Gulf 11-E Mattern, NW NE 12-22-36, flowed 948 bbl. and 1,209,000 cu. ft. of gas, top pay 3,690 ft., T.D. 3,765 ft. in lime.

Cooper: Western Gas Co. 1-A Toby, NE NE 13-24-36, flowed 75 bbl. naturally through open 2-in. at 3,607 ft., top pay 3,495 ft., T.D. 3,607 ft.

Maljamar: Martin Yates, Jr., 1 State, NE SE 32-17-32, flowed 100 bbl., top sandy lime 3,475 ft., T.D. 3,490 ft., sand, shot.

Barney Cockburn 1-B Miller, SW SW 35-17-32, dry, T.D. 4,200 ft.

Salt Lake: Continental Oil 1 Smith 18, NW NE 18-20-33, pumped 182 bbl. 15 hr., top pay 3,016 ft., T.D. 3,034 ft.

West Eunice: Wilson Oil 8 State, NW SW SE 13-21-34, flowed 1,250 bbl. 6 hr., naturally, top pay 3,752 ft., T.D. 3,760 ft., lime.

TEXAS PANHANDLE

AMARILLO, Tex.—Seven completions were recorded during the week for the Panhandle field. Five were oil wells, one gas and one dry hole. Total potential was 756 bbl. and the gasser was good for 24,500,000 cu. ft. a day. Four wells were abandoned because of the M-68 spacing rule. Three of these were in Gray County and one in Hutchinson County.

The Panhandle field gained in daily production last week with an average of 84,300 bbl., topping the previous week's average by 8,400 bbl. The per-well average for the 5,538 wells on production was 15.2 bbl. a day.

TEXAS PANHANDLE COMPLETIONS

Hutchinson County: Huber Corp. 25 Weatherly, Sec. 26, Blk. Y, A.&B. Sur., pumped 420 bbl., pay 2,887-2,965 ft., T.D. 2,980 ft.

Dave Rubin 3 Whittenburg "A," Sec. 33, Blk. 47, H.&T.C. Sur., 60 bbl., pay 2,814-60 ft.

Stekoll Oil 3 Whittenburg "A" North, Sec. 37, Blk. M-23, T.C.R.R. Sur., pumped 110 bbl., pay 2,940-3,045 ft., T.D. 3,050 ft.

M. B. Armer 3 Luginbyhl, Sec. 4, Blk. J, T.W.&N.G. Sur., pumped 83 bbl., pay 3,091-3,160 ft., T.D. 3,163 ft.

Hollandsworth Drlg. 6 Groves, Sec. 28, Blk. M-23, T.C.R.R. Sur., pumped 83 bbl., pay 3,174-3,226 ft.

Phillips Pet. 3 Katherine, Wm. Cole Sur., dry, T.D. 3,365 ft.

Moore County: Shamrock Oil & Gas 1 Burnett, Sec. 267, Blk. 44, H.&T.C. Sur., 24,500,000 cu. ft. of gas, 3,065-3,290 ft., T.D. 3,401 ft.

Western Kentucky

(Continued from Page 268)

Floyd County: Kentucky-West Virginia Gas Co. 5370, Solomon Akers, on Mud Creek, 1,841,000 cu. ft. of gas, T.D. 1,902 ft. in Big lime.

Kentucky-West Virginia Gas Co. 665 H. W. McCoy, T.D. 2,470 ft., 112,000 cu. ft. of gas, shot.

Kentucky-West Virginia Gas Co. 666 W. A. Blankenship, T.D. 2,860 ft., 133,000 cu. ft. gas.

Knott County: Kentucky-West Virginia Gas Co. 5346 Thomas Hall, Dry Creek, dry at 3,316 ft. in shale.

New Eastern Venezuela Field Is Indicated by Mene Grande Well

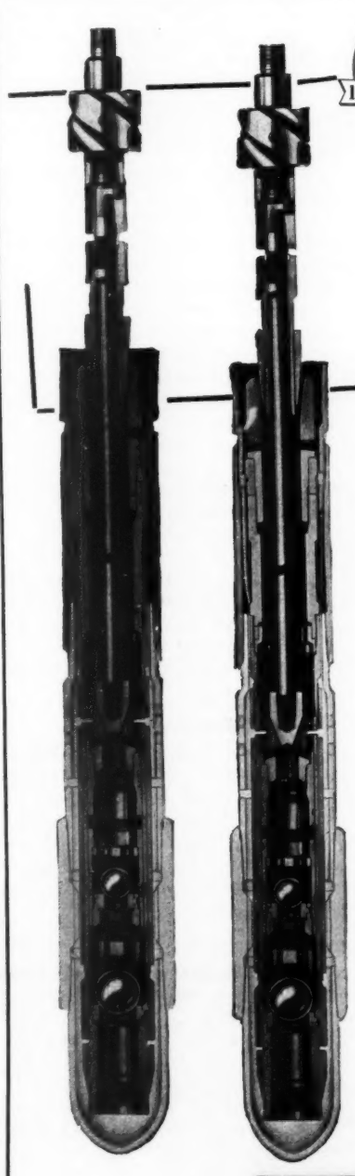
NEW YORK, Mar. 24.—Another new eastern Venezuela field is indicated by showings encountered in the Mene Grande Oil Co. 1 Quiamare in northeastern Anzoategui. This well, drilled to 9,055 ft., is being tested now and a number of productive sands have been proven. It is estimated that the well will be good for several thousand barrels per day.

The last show was encountered at 7,300 ft. and flowed 500 bbl. per day through a ¼-in. choke on test. The other productive zones were found at greater depths as testing proceeded up the hole. Additional potentially productive zones are yet to be tested. The last zone consists of approximately 50 ft. of sand. The gravity of the oil is reported to be about 38° A.P.I.

The Quiamare well is the most northern producer yet drilled in the State of Anzoategui. It is about 30 miles south of Puerto La Cruz and less than 10 miles west of the Oficina-Puerto La Cruz pipe line of the Mene Grande Oil Co. and Standard Oil Co. of Venezuela.

The new area is north and east of the Santa Rosa field which Mene Grande opened last year and is west of the Santa Barbara field opened by Venezuelan Petroleum Co. in the neighboring State of Monagas, also a 1941 discovery.

This was the second indicated discovery of this year for Venezuela. Earlier Sociedad Anonima Petrolera las Mercedes got production in 2 Mercedes in the State of Guarico. This well, which may be Central Venezuela's first commercial producer, flowed 363 bbl. per day through a ¼-in. choke. The gravity of the crude was reported to be about 35° A.P.I. This well is 125 miles west and slightly south of El Roble.



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OIL AND GAS JOURNAL

Exploration Has Been Reduced By Restrictions Under M-68

(Continued from Page 56)

The much-discussed orders M-68 and P-98, regulating drilling and the use of equipment in oil wells have now been in operation for 3 months and it is interesting to note the effect that they have had on drilling. Comparison of the record of completions in November and December 1941 and January and February 1942 does not give the complete story as a number of wells completed during the last 2 months do not conform to the requirements of the orders but have been permitted to go ahead because they were started prior to the time the orders went into effect. Nevertheless, the effect of the restrictions on drilling is apparent from the data presented in Table 1.

From this table, it will be noted that oil-well completions have declined 42 per cent in 4 months, gas wells are down 54 per cent, dry holes are down 27 per cent, and reported drilling wells are down 43 per cent. In some areas reports show a considerably greater drop in active drilling wells than the figures presented in Table 1.

In Illinois, for example, the state Geological Survey reported 133 drilling wells and 237 standing rigs on December 2, 1941. On March 3, 1942, there were 37 drilling wells and 113 standing rigs. Thus, in this state there is an actual decline of 72 per cent in drilling wells instead of an apparent decline of 60 per cent as shown in Table 1. In most states, the number of drilling wells, including shutdowns, is between one and two times the number of monthly completions. In Indiana, there were 14 completions in February and 74 drilling wells at the end of the month. Obviously most, probably three-quarters, of these wells were shut down. The same is true of the wells reported as drilling in the Rocky Mountain states. A check made on Michigan activities shows only 69 wells actively going ahead instead of the 114 reported. It might be assumed that wells actually drilling were 300 fewer than the total reported for November and 500 fewer than the number reported in February which would show an estimated decline in wells actually drilling of 52 per cent and this estimate is believed to be on the conservative side.

Field Activity

In some districts, the separation of drilling wells into field wells and wildcats is difficult. Many wells in the Gulf Coast region start off as field tests but become wildcats when the regular pays are noncommercial and they go deeper in search of new pays. Table 2 shows the drilling activity in nine areas where approximately one-half of the country's wells are drilled.

The summarized record for these areas shows that there is considerable local variation in drilling activity, due in great part to the variation in opportunities for drilling afforded by discoveries under normal conditions. For the nine areas as a whole, activity in 1941 started at a subnormal level and rose rapidly during the second quarter. There was a lull in activity in the summer but during October, November, and December, there were 1,600 wells drilling, or only slightly below peak activity. This was reduced to 970 wells in January 1942 and 724 in February. This reduction does not take into consideration an estimated 40 wells shut down in Indiana, 57 in Illinois, and large numbers elsewhere.

Of the nine areas, three, namely Indiana, Louisiana-Arkansas, and West Texas had more wells drilling in January 1942 than during the slowest month of 1941 and in the case of the two districts first mentioned, the activity was also greater than the 1941 average. This was due to the shutting down of many tests in Indiana without dropping them from the record and the activity in the Midway field in Arkansas which is on 40-acre spacing. In West Texas, many fields are on 40-acre spacing and others can be rapidly adapted to a 40-acre program. The other areas listed are not easily converted into a wide-spacing program and drilling has fallen off rapidly, even if "temporarily shut down" is considered as "drilling." Illinois, North Central Texas, and East Texas were particularly hard hit with activity dropping below 50 per cent of the 1941 minima.

January's decline was carried into February with Louisiana-Arkansas and West Texas also participating. The only areas where there has not been a sharp decline in drilling wells were Indiana, due to the circumstances referred to above, and East Texas where there can hardly be much less activity. The decline in drilling after 2 months of M-68 has been more than 50 per cent and this is due in great part to a lack of 40-acre locations.

Wildcat Drilling

Under normal conditions dry holes make up between 20 and 25 per cent of the total number of wells drilled. Converting all fields into 40-acre spacing increases the hazard. Thus, when the average operator, who has to make three or four producers pay for the dry hole finds the risks increased, he is not only likely to reduce his field activity but as a necessary consequence, reduces his wildcatting also. In 1941, the average number of wildcats drilling at any time was 406 and the average number of field wells was 1,540 or slightly more than four times as many. In February with field wells standing at 724, wildcats were reduced below the average 1941 level, although not proportionately. At the end of the month there were 236 wildcats drilling, or approximately one-third the number of field tests.

Wildcatting has dropped 42 per cent from the

TABLE 1—COMPLETIONS IN ALL DISTRICTS, NOVEMBER 1941-FEBRUARY 1942

	Oil wells				Gas wells				Dry holes				Drilling			
	Nov.	Dec.	Jan.	Feb.	Nov.	Dec.	Jan.	Feb.	Nov.	Dec.	Jan.	Feb.	Nov.	Dec.	Jan.	Feb.
Appalachian	419	390	335	363	113	122	81	56	25	25	12	16	697	602	505	520
Ohio	53	31	27	11	74	45	48	26	53	44	45	19	251	234	153	94
Kentucky	19	18	12	1	20	33	2	12	19	14	10	8	143	155	62	62
Michigan	67	55	36	32	16	13	9	2	25	30	18	23	170	162	123	114
Indiana	18	29	24	6	7	4	4	1	24	18	22	7	80	72	71	74
Illinois	250	169	163	72	1	1	2	1	81	77	73	35	388	363	187	155
Kansas	94	91	92	82	6	11	9	3	52	46	37	50	243	260	163	132
Neb., Mo., Iowa	3	2	2	1	0	0	0	0	7	7	2	4	21	9	10	2
Oklahoma	80	105	77	53	12	13	13	17	32	73	50	46	336	296	213	174
N. Cent. Texas	156	107	142	44	4	5	5	2	95	61	78	51	267	288	111	50
West Texas	208	142	169	134	1	3	2	0	22	15	18	14	314	340	282	208
Texas Panhandle	74	54	61	31	12	6	12	8	2	6	0	0	74	70	48	25
East Texas	53	35	36	21	4	3	4	4	17	9	19	10	97	87	33	18
Upper Gulf Coast	77	65	71	54	5	1	4	2	15	6	19	24	116	141	101	91
Southwest Texas	81	90	84	54	8	5	10	2	35	44	67	34	222	216	208	142
Arkansas	6	4	5	2	4	3	3	3	4	3	5	5	30	28	22	20
Mississippi & SW	19	24	6	5	0	0	0	0	6	7	3	3	35	32	15	28
N. Louisiana	38	47	28	25	9	10	5	0	22	33	26	22	89	96	79	27
Louisiana Gulf	47	48	46	35	2	0	0	0	20	10	22	13	151	140	90	84
Montana	10	13	10	8	5	11	5	4	3	6	5	0	98	72	60	71
Wyoming	13	2	6	6	1	0	1	0	3	1	1	3	63	61	60	57
Colorado, Utah	0	1	0	2	1	0	0	0	2	2	1	1	48	46	42	32
New Mexico	19	13	18	14	0	0	0	1	5	5	6	6	106	100	97	95
California	96	62	70	46	4	3	8	2	16	3	28	31	174	170	132	102
Total	1,900	1,599	1,520	1,102	309	292	227	142	585	545	567	426	4,203	4,038	2,807	2,377

TABLE 2—FIELD TESTS DRILLING

	1941 Maximum	Month	1941 Minimum	Month	1941 Average	1942 Jan.	1942 Feb.
Indiana	54	Nov.	23	Jan.	42	52	54
Illinois	312	Aug.	229	Feb.	254	114	79
Kansas	251	June	142	Sept.	206	122	100
Oklahoma	326	Oct.	196	Feb.	264	163	132
N. La.-Ark.	92	Sept.	48	Feb.	75	78	33
West Texas	303	Apr.	191	Aug.	254	246	177
N. Central Texas	255	Apr.	171	Aug.	217	81	34
East Texas	88	Mar.	61	Feb.	76	14	13
California	163	May	122	Mar.	138	101	71
Total	1,626	May	1,339	Feb.	1,526	971	726

TABLE 3—WILDCATS DRILLING

	1941 Maximum	Month	1941 Minimum	Month	1941 Average	1942 Jan.	1942 Feb.
Indiana	41	Feb.	22	Dec.	33	19	20
Illinois	105	May	80	July	94	73	76
Kansas	53	Dec.	25	Jan.	39	41	32
Oklahoma	83	July	48	Feb.	62	50	42
N. La.-Ark.	34	Oct.	15	Feb.	23	25	14
West Texas	42	Jan.	22	Aug.	31	31	30
N. Central Texas	78	Apr.	59	July	68	31	16
East Texas	38	Jan.	17	Sept.	23	19	5
California	40	Sept.	20	Jan.	30	31	30
Total	426	May	385	Mar.	403	320	235

1941 average in 2 months, again without regard for shut down wells of which there are 54 in Illinois out of a total of 76 theoretically drilling wells. Table 3 shows the relationship between wildcatting activity now and in 1941 for the same areas as are discussed in Table 2. Out of the nine areas involved, Indiana, Illinois, and North Central Texas started the year below the minimum level of 1941 and North Central Texas shows a further drop in February. Oklahoma and East Texas started off in January with more than the 1941 minimum but less than the 1941 average and both have declined further in February. Kansas and Louisiana-Arkansas had more than the 1941 average drilling in January but fewer in February. West Texas and California are continuing at the 1941 average level.

The area in which most wildcatting is being conducted in California is in districts where 40-acre spacing is quite feasible and the same is naturally true of West Texas. All of the other areas discussed do not, either by tradition or because of the type of structure involved, lend themselves to 40-acre spacing universally.

Operators point out that there is more to producing oil than engineering. The matter of economics is also very important. The average chances for success in wildcatting are about 1 in 8 or 10. If a well is drilled on 10-acre spacing, the average successful wildcat will have eight offset wells which have a reasonably good chance of paying out. Of course, many fields are drilled following the discovery of an edge well, but even an edge well will have two other edge and three inside offsets. The return from a discovery is thus not 1 in 8, in terms of producers but 6 in 14 or 9 in 17, depending on the position of the offset with relation to the field.

Large Leases Favored

However, many fields are found which cover around 100 acres but do not extend over 360 acres, which would be required if the chances were to be equal on 40-acre spacing. In areas such as West Texas, this is not true as most fields are much larger. Hence, wildcatters will take more chances there under 40-acre spacing than in other areas, particularly when the unit lease is normally 640 acres or more.

The drilling of wildcat wells seems definitely to be on the down grade at present and it appears that some encouragement must be given the wildcatter in addition to permitting him to get equipment. A blanket exception to offsets of discoveries might accomplish this end and would give adequate data to determine future drilling practice in the field.

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A.S.M.E. Meeting in Houston Attracts Large Attendance

HOUSTON, Tex., Mar. 24.—"Engineering Production for Victory" was the keynote of the spring meeting of the American Society of Mechanical Engineers which got under way at Houston, Tex., March 23 and lasted 3 days. In spite of the strenuous conditions under which most engineers are now working, many members of the society contributed papers of such outstanding excellence as to attract attendance from all over the country, and registrations Monday indicated an attendance of several hundred members.

The society recognized the importance of the spring meeting by holding a special meeting of the council Monday morning. Prominent ordnance officers of the U. S. War Department were scheduled to address the convention later in the week. Brig. Gen. Earl McFarland was slated to be the principal banquet speaker Tuesday evening, and Lt. Col. D. J. Martin was to deliver an address on the subject of manufacture of large guns.

Other speakers on the program to speed war production included: Dr. E. L. De Golyer, director of conservation, Office of Petroleum Coordinator for National Defense, Washington, D. C.; James W. Parker, president of the A.S.M.E., and vice president of the Detroit Edison Co., Detroit, Mich.; Col. William B. Tuttle, chairman of board of directors, San Antonio Public Service Co., San Antonio, Tex.; John E. Younger, chairman, mechanical engineering department, University of Maryland, and Harte Cooke, engineer, diesel division, American Locomotive Co., Auburn, N. Y.

The annual meeting of the student branches in Group 7, otherwise known as the Southwest group, was also held in conjunction with the meeting of the society. The colleges included in this group are the University of Arkansas, Oklahoma A. & M. College, University of Oklahoma, Rice Institute, Southern Methodist University, Texas A. & M. College, Texas Technological College, and the University of Texas. Approximately 20 student papers were to be presented in a contest for some $200 in prizes. The student sessions were held Monday and Tuesday and prizes were to be awarded to the winners Tuesday night.

One of the special features of the meeting were the two aviation sessions with nationally prominent speakers, and two inspection trips to aeronautical centers in and near Houston. This feature of the program was timely in view of the recent expansion of aeronautical developments in Texas and the increasingly prominent part this section of the country will play in the nation's aviation business. J. L. Atwood, vice president and general manager of North American Aviation, Inc., was scheduled to speak on the expansion of aircraft production, and Jerome Lederer, director of the safety bureau of the Civil Aeronautics Board, was to discuss the use of motion pictures in accident analyses. Other speakers on the program include: Dr. John E. Younger, national chairman of the aviation division of the American Society of Mechanical Engineers; Prof. W. H. Barlow, head of the department of aeronautical engineering A. & M. College of Texas; Dr. M. J. Thompson, graduate professor of aeronautics at the University of Texas, and Prof. R. M. Pinkerton, of University of Texas.

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Interstate Oil Movement Reflects Dislocations

EVIDENCE of the dislocation of petroleum transportation that has since grown into the major problem now facing the oil industry and consumers in the northeastern quarter of the United States was apparent to a slight extent as early as January. The trends which have since become sharply defined by the inability to maintain normal shipments from southwestern producing states were indicated in the Bureau of Mines monthly refinery report for January released last week.

Interstate shipments of crude oil during January totaled 48,036,000 bbl., the highest reported since the previous October and more than 6,000,000 bbl. greater than in the same 1941 month. Shipments from Louisiana reached a new peak of 6,163,000 bbl. in January which reflects the greater use of the Mississippi River system. Oklahoma shipments increased 57,000 bbl., daily, reflecting replacement of declines in Illinois.

New Mexico's shipments declined 10,000 bbl. in January, bringing its outbound oil traffic to the level of February, 1941, which was the lowest in recent years. The downward trend of shipments from New Mexico has continued unabated and the state is now delivering nearly 20,000 bbl. per day less crude than during the latter part of 1941.

There was a comparatively modest decline of 2,000 bbl. in the daily shipments from Texas in January, a trend that has been magnified several times during the intervening 54 days.

A slump of 26,000 bbl. in the daily interstate shipments of Illinois crude reported in January was chiefly a reflection of the decline in production caused by the interruption in normal drilling operations.

Interstate peroleum movement by pipe lines in January totaled 26,935,000 bbl., a daily average of 869,000 bbl., compared to 861,000 bbl. daily in December and with 24,212,00 bbl., in the same month last year. Interstate pipe-line deliveries averaged 2,078,000 bbl. daily last January against 2,196,000 bbl. in December and 1,815,000 bbl. per day a year ago.

Movement of domestic crude oil by trucks, railroads and marine vessels was lumped together in the January report to prevent disclosure of the volume shipped from Gulf Coast ports. Shipments by other methods totaled 26,260,000 bbl. in January, 25,219,000 bbl. in December and 29,268,000 bbl. in January, 1941.

INTERSTATE SHIPMENTS OF CRUDE OIL

	January 1942	January 1941
Illinois	6,967,000	6,354,000
Kansas	3,661,000	2,739,000
Louisiana	6,163,000	5,494,000
New Mexico	2,600,000	3,544,000
Oklahoma	10,012,000	7,999,000
Texas	12,199,000	12,064,000
Others	6,434,000	4,105,000
Total	48,036,000	42,299,000

Adjustment of Panhandle Crude Prices Is Denied

AMARILLO, Tex., Mar. 24.—A request of several Texas producers to equalize maximum prices for Texas Panhandle crude with those established for Oklahoma and Kansas oils, was denied last week by OPA.

Request for removal of a 10-cent-per-barrel differential in favor of the Oklahoma and Kansas crude oils came from the Panhandle Producers and Royalty Owners Association of Amarillo, Tex., and J. P. Coleman of Wichita Falls, Tex. Their request was made on November 24, 1941, and was followed by an investigation by the OPA Fuel Division.

In denying the request for an equalization of prices for the two fields, John E. Hamm, acting administrator, said in part:

"There is strong economic justification for the existence of a price differential between the two areas because of the less favorable geographic position of the Panhandle and because Panhandle crude oil has certain undesirable qualities which lead to higher refining costs.

"While it would be extremely difficult to determine whether the proper differential is the existing differential or one of a cent higher or lower, it is true that the present differential of 10 cents is the lowest that has obtained in a long period. Panhandle crude prices have increased more than those in any of the surrounding areas in recent years. Any further increase at a time when inflation threatens our effective prosecution of the war seems unjustified on the basis of the information submitted."

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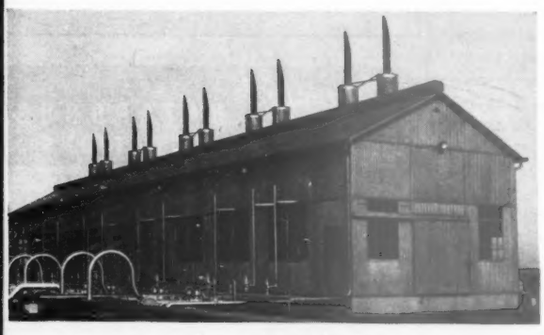

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Texas Panhandle Feeling Effects Of War-Brought Regulation

By HARRY F. SIMONS

AMARILLO, Tex., Mar. 24.—The Texas Panhandle is at present recovering from the effects of regulation brought on by the war and is attempting to get situated to carry on successfully during the next few years.

The most favorable part of the picture is the demand for the crude from the area. The more or less sour oil has been used in recent years for the manufacture of lubricating oils. Under the present conditions, there is a better demand for the area's products while the demand in other parts of Texas and the nation are declining. This is reflected by the recent market-demand hearing in Austin, Tex., where every area except the Panhandle had its allowables cut; the Panhandle remained the same at 99,778 bbl. for April. One of the major purchasers in the area (Humble) indicated it could use all of the Panhandle crude available while another (Phillips) indicated it could use 45,000 bbl. daily.

Most of the new work is being directed toward increasing the gas supply, although this is due mainly to the curtailment of oil prospecting order M-68. The gas produced in the area is sold to pipe lines to be transported to industrial centers, is used for the manufacture of gasoline and for reforming to aviation fuel, and the residue sour gas is used for the manufacture of carbon black. There is practically no waste of sweet gas at the present time.

The production of natural gasoline in the Panhandle is decreasing steadily as plants are remodeled and improved to make finished motor fuel and lighter products, such as butane, propane, etc. Currently, these are the most marketable products.

Carbon Black Industry in Peril

The fate of the carbon-black industry, a major item in the Panhandle where there is the world's largest concentration of the industry, is figuratively hanging in the balance. More than 90 per cent of the carbon black produced has been used in the manufacture of rubber goods and until the course of the rubber industry becomes more definite plant operators will not know which course to follow. Synthetic rubber will probably require a poorer grade of carbon black although it is expected that the percentage of carbon black in rubber products will be increased.

For the present the plants are operating at a slightly reduced pace and will probably continue to do so although stocks of carbon black are piling up. Actually, it is very costly to discontinue operations at a carbon-black plant principally because of the rapid rate at which the equipment deteriorates. The gas used to make the carbon black is sour and sulfur products are a byproduct. As long as the plants continue to operate the corrosion is not severe as little moisture is present, but as soon as the plants shut down rusting develops quickly. Within 2 months after shutting down, much of the equipment is beyond repair and the plants have to be rebuilt. The only means of preventing the corrosion is to entirely dismantle the sheds and scrape and brush the metal and paint it, and this is impractical.

The rule making it mandatory to strip the sour gas of liquid before running it through the carbon-black plants is proving a severe handicap to the operators. The operation of some of the plants definitely becomes marginal because of the relatively high cost of stripping. The gas contains only 0.35 gal. of gasoline per 1,000 cu. ft. and the gasoline plants operate at a definite loss. In time this factor will make operation of some of the plants virtually impossible from the economic standpoint.

Drilling Down

Drilling activity has declined markedly in the past few months. At the present time there are 73 tests being carried by the scouts but only 39 of these are active and 34 are shut down. Most of the inoperative tests are waiting on exemptions or clarification of the 40-acre spacing order. Following is the list of drilling by counties:

County—	Active	Shut down
Wheeler	3	3
Potter	1	0
Moore	1	3
Swisher	1	0
Lamb	1	0
Hutchinson	19	18
Gray	11	9
Cottle	0	1
Carson	2	0
Total	39	34

Recently there was a flurry of activity around the Huber Corp. farmout from Humble Oil & Refining Co. in Hutchinson County about 7 miles northwest of Stinnett. Production is from a reworked limestone below the dolomite with wells averaging 230 bbl. per day initially. The last well completed in the pool was the best, making 408 bbl. per day. There is little more development to be done in this area.

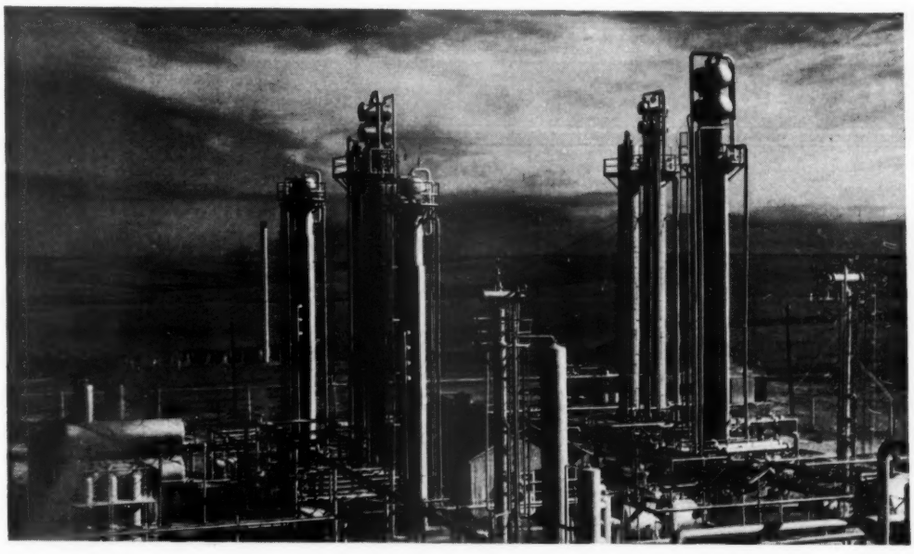
Another area which was particularly active late last year is now at a standstill. This is the Little Seminole pool in Gray County 4 miles south and 2 miles west of the town of Lefors. Production is from the the Brown dolomite and an arkosic dolomite with the wells averaging initially from 200 to 400 bbl. a day. The pool is now within about pected to increase. Drilling restrictions have not been in effect long enough to affect the supply of crude, but eventually they will be felt.

Some measure of productivity of the area was obtained recently when the allowable of the field was boosted to 31 bbl. for a 20-acre well and 25 bbl. per day for a 10-acre well and the wells allowed to produce 25 days per month. It was found that many wells could not produce this allowable in 30 days and they have been cut back. Texas is now operating on a 13-day shutdown schedule, and it is expected that many of these wells will now be able to produce the lower allowable. About 15 per cent of the wells were not capable of meeting this increased rate of production and about 50 per cent of the 5,500 wells in the pool were almost at capacity when producing the larger amount. There was also an indication that lifting of production restrictions would have an adverse effect on the ultimate recovery from many of the wells.

Wildcatting in the general area is expected to increase as the field work will be greatly curtailed. About 80 per cent of the field has been developed on 10-acre spacing and except on the larger farms it will be very hard to find 40 acres to allot to a well. Instead of a 75 per cent reduction in available drilling sites the reduction is greater than 90 per cent.

a mile of the Davidson pool which is to the northwest. A dry hole drilled by Smith Brothers on the Shaw farm, NE Section 28, Block 1, A.C.H.&B. Survey, was a disappointment as it had been hoped that the Brown dolomite trend might be extended 4 miles. A new test is starting 2 miles southeast of Little Seminole and may cause more development in the area. It is the Eben Warner test on the Taylor farm, NW Section 5, Block H, A. W. Wallace Survey.

Companies are now studying the means of cleaning out and repairing wells to maintain the production instead of drilling new ones. There is some of this work going on now and it is ex-



Natural-gasoline plant combined with isobutane and isopentane-manufacturing equipment. The plant is operated by Hagy-Harrington & Marsh in the Texas Panhandle

MICHIGAN OPERATIONS

More Abandoned Locations Than Completions Reported

By OTTO C. PRESSPRICH

SAGINAW, Mich. — Michigan oil activity dwindled further last week with only one small producer, classed as a wildcat, and three other tests completed as dry holes. Operators also announced abandonment of five locations, due to the federal control program. The state Conservation Department issued only three drilling permits, bringing the total for the year to 93. The permits are for tests in Arenac, Lake and Montcalm counties.

Michigan oil production in February declined nearly a quarter-million bbl., compared with January, the Michigan Oil and Gas Association reported, as the daily average of 49,119 bbl. was maintained only slightly higher than the federal quota. The output was 1,375,340 bbl., lowest since August of 1941. Reed City's reduction was the biggest, amounting to 138,000 bbl., the Roscommon field output dropped 22,250 bbl. and that of Winterfield-Clare declined 19,295 bbl., compared with January. The April quota has been increased to 50,200 bbl. a day.

Of interest in current operations is the American Drilling Co. test in Section 33 of Roscommon Township, Roscommon County. The well is a quarter-mile northwest of present production in the state's biggest Traverse formation pool.

Pure Oil Co., getting about 125 bbl. a day from its 1 Vincent in Section 6, Richmond Township, provided a quarter-mile extension to the south of the Reed City-Osceola field and Ohio Oil Co. was nearing the Monroe in its 1 Walker in Richmond Section 6, a mile south of the Vincent. In Adams-Arenac Ervin Major 1 Adams, Section 36, made a good showing of oil at about 4,200 ft. The well is a mile east of production in the old South Adams pool.

MICHIGAN COMPLETIONS

Allegan County, Hopkins Township: Sprenger Bros. 1 Wamhoff, NE SW SE 7-3n-12w, location abandoned.

Gladwin County, Sherman Township: Ervin Major 1 State of Michigan, W½ SW NW 18-20n-2w, wildcat test, dry at 4,187 ft.

Genesee County, Forest Township: J. C. Glavin 1 Smith, N½ SE SW 5-9n-8e, wildcat test, dry at 3,117 ft.

Ottawa County, Polkton Township: Associates Petroleum Co. et al 1 Blackmer, NE SE NE 15-8n-14w, wildcat, 14 bbl. initial, with salt water, acid-treated, T.D. 1,890 ft.

Sanilas County, Greenleaf Township: Charles W. Teater 1 Cosgrove, C-W½ SW NW 14-14n-12e, wildcat, dry at 2,795 ft.

Lake County, Pinora Township: Pure Oil Co. 3 Morrison, C-N½ SE NE 25-18n-11w, location abandoned.

Pure Oil Co. 4 Morrison, C-S½ NE NE Sec. 15, location abandoned.

Osceola County, Lincoln Township: Pure Oil Co. 3 Campbell, C-N½ NW SW 19-18n-10w, location abandoned.

Pure Oil Co. 4 Campbell, C-NE SW Sec. 19, location abandoned.

MICHIGAN CRUDE-OIL PRODUCTION

(Daily average for February 1942)

Pool—	Wells	Run
Porter-Yost	336	3,767
Greendale-Chippewa	176	1,113
Sherman-Isabella	64	509
Vernon-Leaton-Denver	76	890
Wise-Isabella	60	738
Reed City-Osceola	146	16,496
Lincoln-Clare	1	0
Freeman-Redding	130	3,082
Winterfield-Clare	29	2,937
Beaverton-Grout	31	385
Buckeye-North and South	275	1,503
Edenville	26	135
Bentley	36	269
Genesee County	1	0
Ogemaw County	222	1,008
Adams-Arenac	46	2,747
Clayton-Arenac	45	592
Kawkawlin-Bay County	37	1,234
Roscommon County	12	2,912
Saginaw City	56	6
Birch Run	26	28
Dundee-Monroe	23	212
Crystal-Wyman	31	223
Amble-Montcalm	4	52
Muskegon	28	34
Holland-Zeeland	1	4
Allegan—all pools	482	3,336
Walker-Wyo-Tallmadge	531	2,511
Van Buren, all pools	238	2,103
Barry County	2	0
Tuscola-Wisner	9	92
Total	3,180	49,119

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SUBMITTED BY L. O. PULLIAM, OKLAHOMA CITY, OKLA. — Johnston

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ROCKY MOUNTAIN AREA

Spacing Pattern Agreed On In Kevin-Sunburst Field

By T. R. INGRAM

DENVER, Colo. — An agreement has been reached between the engineers of the U. S. Geological Survey and the Montana Railroad Commission on the pattern for well spacing in Kevin-Sunburst based on the geographical location of the first well spudded this year, which was in the southeast corner of a 40-acre tract. The agreement has been forwarded in triplicate to the OPC in Washington for interpretation under Order M-68, with copy to the manager of the OPM for the district in Denver. Michael J. Foley, the district manager, will submit recommendations to the Washington office, which will issue any order of approval. There is some confusion regarding agreement on a pattern for the Cut Bank field arising out of wells spudded on tribal leases west of Cut Bank Creek and the field to the east. Geographical locations of the first wells spudded in the two districts do not agree, and the question has arisen as to whether the two areas shall be considered as separate pools or one.

Yale Petroleum 1 Atherly, SW SW SW 33-52n-100, an outside well on the north dome of the Oregon Basin field, flowed 30 bbl. an hour from the Embar at 3,534-88 ft. This well originally was drilled in 1929 by the old Producers & Refiners Corp. and completed as a gas well in the Sundance at a total depth of 2,785 ft. It is on the northeast flank about 1 mile from the top of the structure and in a fault block ⅛ mile wide extending entirely across the dome from the northeast to the southwest. Deepening recently was started to test the Embar.

Sinclair-Wyoming 104 Lost Soldier, which was reported a completion last week in the Tensleep for 105 bbl. in 18 hours on a swabbing test, made 468 bbl. a day on gas lift.

The two outstanding wildcats in Wyoming are both headed for deeper horizons. Sinclair-Wyoming 1 Mary Carter, on the Sherrard dome, will go to the Madison. It had the top of the Tensleep at 5,047 ft., where it had a showing of oil followed by sulfur water at 5,105 ft. Superior Oil 1 Tribal, Pilot Butte field, cemented the 7-in. through the Tensleep at 6,446 ft., but will not test showings in this horizon at this time, and will drill deeper.

Two new locations were reported in the Hardin gas field in Big Horn County by the Big Horn Oil & Gas Developing Co. The gas is found in the Frontier at around 600 ft. The operation started several years ago when residents sank wells on their own property for a domestic supply for the family. Since then it has become a better organized development and its output is now used largely for industrial purposes in the town of Hardin. There were 61 producing wells in the field on January 1, 1942,

(Continued on Page 279)

CANADIAN FIELDS

Turner Valley West Flank Test Is Abandoned

By VICTOR LAURISTON

CHATHAM, Ont.—Crude and natural-gasoline production from Alberta fields in January totaled 862,284 bbl., or 27,815 bbl. daily, a decrease of 176 bbl. daily from December but an increase of 2,388 bbl. daily over January 1941. The January production included 586 bbl. of shallow crude, 3,276 bbl. of naphtha, 816,704 bbl. of limestone crude, and 32,121 bbl. of natural gasoline from Turner Valley.

Four Turner Valley absorption plants processed 3,274,821,000 cu. ft of natural gas to produce 32,121 bbl of natural gasoline, of which 22,197 bbl. came from limestone gas wells and 9,924 bbl. from limestone crude wells. The daily average of 1,036 bbl. of natural gasoline compared with 902 bbl. in January 1941.

Natural-gas production in January totaled 5,862,174,000 cu. ft. compared with 6,088,411,000 cu. ft. in December and 5,917,326,000 cu. ft. in January 1941. The production from the various fields, in millions of cubic feet was: Turner Valley, 4,763,394; Foremost, 46,129; Viking, 156,559; Kinsella, 440,546; Medicine Hat, 318,033; Redcliff, 34,484; other fields, 102,029. Of the Turner Valley production, 1,881,457,000 cu. ft. came from gas wells and 2,881,937,000 cu. ft. from oil wells. Turner Valley gas wastage in January was 2,516,980,000 cu. ft. compared with 2,628,801,000 cu. ft. in December.

Current Production Figures

Crude and natural-gasoline production from Alberta fields for the week ending March 9 averaged 29,649 bbl. daily compared with 29,857 bbl. daily for the previous week and 26,514 bbl. daily for the corresponding week last year. The daily average included 28,304 bbl. of crude and 1,036 bbl. of natural gasoline from Turner Valley and 309 bbl. of crude from outside fields. There were 203 producing wells, 39 drilling, 1 finished, 7 testing, 1 standing, 1 abandoned, 3 new wells were spudded, and 1 new drilling license.

Deep Test Abandoned

In North Turner Valley, Royalite 62, LSD 3, 22-20-3w5, bottoming at 8,990 ft., with Madison at 8,832 ft., has been abandoned. The test, some distance down the west flank of the structure, got the lime very deep and was carried through only the upper zone, where water was encountered.

TURNER VALLEY LIME TESTS

North Turner Valley: Atlas-British Dominion 2, LSD 4, 17-21-3w5, T.D. 8,710 ft., Madison at 8,285 ft., continuing tests, flowing 900 to 925 bbl. daily.

Foothills Oil & Gas 11, LSD 11, 4-21-3w5, T.D. 7,422 ft., Madison at 6,878 ft., completing tests.

Foothills Oil & Gas 10, LSD 2, 4-21-3w5, T.D. 8,069 ft., Madison at 6,619 ft., acidizing and testing.

West Central section: Gem Royalties 1, LSD 4, 36-19-3w5, resuming after getting Madison lime at 7,065 ft. and setting casing at 7,081 ft.

Anglo-Canadian Oils 11, LSD 5, 25-19-3w5, T.D. 8,119 ft., Madison at 7,885 ft., testing upper porous zone.

Test Southwest Extension

Northwest-Hudson's Bay 8 has been spotted in LSD 2-3, 8-18-2w5, to test a possible southwest extension of the field. Location is a little south of Northwest-Hudson's Bay 6 producer. For several years, Northwest, subsidiary of Imperial Oil, and Hudson's Bay Co. have been systematically testing the latter company's acreage in 8-18-2w5. After a series of good average producers, No. 6, the outpost well to the southwest, was finished as a large producer, with

(Continued on Page 283)

Rocky Mountain Area

(Continued from Page 278)

and production last year was 82,000,000 cu. ft., about the same as in 1940.

WYOMING COMPLETIONS

Goose Egg district, Natrona County: Iba Development 1, C NE SE 25-32n-82w, T.D. 1,885 ft., lost hole, skidded rig and spudded in No. 1-A.

Oregon Basin field, Park County: Yale Petroleum 1 Atherly, SW SW SW 33-52n-100w, flowing 30 bbl. an hr. from Embar, top 3,534 ft., after acidizing, T.D. 3,588 ft.

MONTANA COMPLETIONS

Cut Bank field, Glacier County: R. C. Tarrant 9 Haglund, Jr., SW SE 13-34n-6w, Sunburst dry at 2,730-50 ft., Cut Bank 2,760-2,830 and 2,844-55 ft., top Madison 3,005 ft., 2,000 ft. sulfur water, dry at 3,010 ft.

Glacier Production 4 Whetstone, SE NW 7-33n-5w, 7-in. 2,876 ft., light show oil in Sunburst 2,832-50 ft., Cut Bank 2,875-2,920 ft., main pay 2,914-20 ft., swabbed 90 bbl. first 24 hr., shot, some increase, T.D. 2,921 ft.

LEGAL

United States Department of the Interior, District Land Office, Las Cruces, New Mexico. Notice is hereby given that the lands herein described in the Artesia Oil and Gas Field, New Mexico are offered to the qualified bidder of the highest amount offered per acre as a bonus for the privilege of leasing the lands under section 17 of the leasing act as amended by the act of August 21, 1935 (49 Stat. 675; 30 U.S.C. 185) at the royalty rate scale in the lease form shown in Circular 1386 at a sale to be held in the United States Land Office at Las Cruces, New Mexico at 10 o'clock A.M. April 22, 1942 in the following parcels: Parcel #1, T. 18 S., R. 27 E., Sec. 1, SE¼; Parcel #2, T. 18 S., R. 27 E, Sec. 12, all. The successful bidder must deposit on date of sale with the officer in charge of the sale a certified check on a solvent bank or cash for one-fifth of the amount bid by him and file the showing of qualifications to receive a lease required by section 7 of Circular 1386. The remainder of the bonus and the annual rental at the rate of $1.00 per acre must be paid and a $5000 corporate surety bond must be furnished prior to the issuance of the lease. Bids may be submitted for both parcels of land provided the aggregate acreage of such parcels and all other holdings of the bidder in the Artesia field is not in excess of 2560 acres, separate leases to issue for each parcel. Bidders are warned against violation of section 59, United States Criminal Code, approved April 4, 1909, prohibiting unlawful combination or intimidation of bidders. The right is reserved to reject any and all bids in the discretion of the Secretary of the Interior. Register.

LEGAL

NOTICE IS HEREBY GIVEN that there will be a meeting of the State Mineral Lease Commission of Mississippi in the office of the Governor at the State Capitol in Jackson, at 10:00 o'clock a.m., April 20th, 1942. The purpose of this meeting is to receive written bids or proposals for the leasing for oil and gas development of the area on the southern coast of this State known and referred to generally as the Mississippi Sound. It is estimated that this area involves approximately 600,000 acres. The property may be leased as a whole or in parts. The Commission is primarily interested in proposals offering prompt and systematic development of said property for oil and gas development.

This March 16th, 1942.

STATE MINERAL LEASE COMMISSION

BY: GREEK L. RICE, Secretary.

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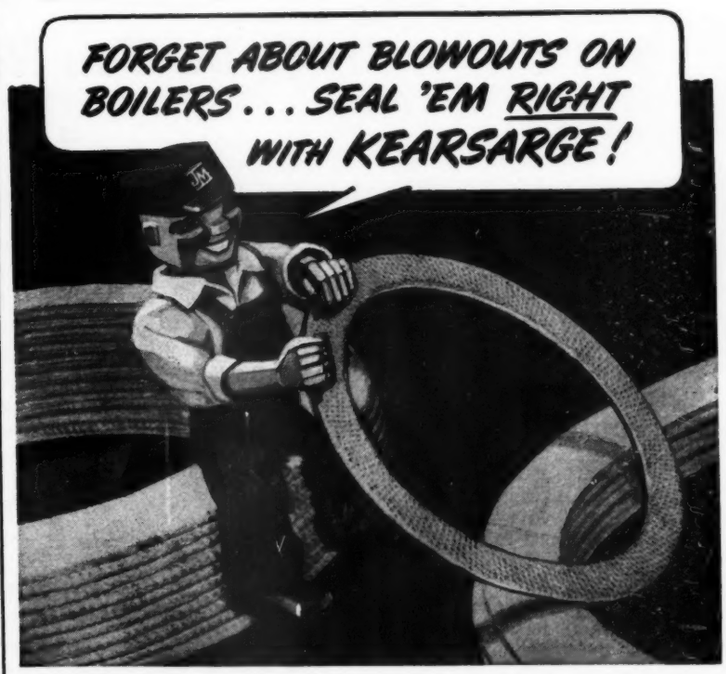

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Personal Paragraphs

R. L. TOLLET, president of Cosden Petroleum Corp., Big Spring, Tex., was honored by more than 275 employes who paid him tribute at a surprise dinner last week. Mr. Tollet was presented with a certificate of appreciation, signed by all employes. DOUG ORME made the presentation and the president responded briefly.

NORMAN H. OTT, president, Wisconsin Petroleum Association, and an executive of Pate Oil Co., Milwaukee, Wis., who suffered a fractured leg in a toboggan accident, has recovered and has resumed his duties.

STEVE R. DENTON, formerly in Stanolind Oil & Gas Co.'s engineering office at Pampa, Tex., has reported to one of the California camps as a second lieutenant.

RALPH C. STEINMAN, chief scout, Sinclair Prairie Oil Co., is the new chairman of the Chief Scouts Club of Oklahoma. He succeeds PAUL L. LYONS, chief scout of Stanolind Oil Purchasing Co. W. R. THAWLEY, head of scouting and statistics for Gulf Oil Corp., is the new vice president, with SAM BAIRD, Mid-Continent Petroleum Corp., reelected secretary-treasurer.

The signal office of the Army air base, Paine Field, Everett, Wash, is well represented by members of the petroleum industry. The signal officer is CAPT. JACK I. LAUDERMILK, formerly of

Gulf Oil Corp. in the Mid-Continent area, and later with University of Texas as instructor of petroleum engineering, who is pictured at the right in the photograph. Captain Laudermilk is the author of several articles on oil operations, some of which have appeared in The Oil and Gas Journal. LT. ROBERT T. BARNES, at left in the picture, is assistant signal officer. He was formerly with Pacific Gas & Electric Co., San Francisco, Calif., as evaluation engineer.

ED DORSEY, on the geological staff of Shell Oil Co., Inc., Midland, Tex., has joined the Army Air Corps.

VERNON HAYES, Lion Oil Refining Co., El Dorado, Ark., is being transferred to Hutchinson, Kans., as superintendent for the company.

STEVE POWELL, scout with Atlantic Refining Co. at Wichita, Kans., for the past 4 years, has left the company to enter military service.

NORRIS C. McGOWEN, president, United Gas Pipeline Co., Shreveport, La., is among 34 Louisianians listed for the first time in the 1942-43 edition of "Who's Who in America."

J. A. TRAUGHBER, superintendent for Transwestern Oil Co., San Antonio, Tex., has been transferred from Hutchinson, Kans., to Oklahoma City, Okla.

E. K. EDMISTON, for many years with the T. C. Johnson interests at Wichita, Kans., as scout and district geologist, has resigned to join the firm of Luther E. Mackall, at Wichita.

J. A. JERGENSEN, geologist for Phillips Petroleum Co., has left Midland, Tex., for California, where he has been assigned to active duty as a commissioned officer in the U. S. Army.

EVERETT C. MAGEE, instrument man for Standard Oil Co. of Louisiana, has received a total of $265 for ideas submitted to the company's Coin-Your-Ideas committee. Of this amount, $240 was for an idea covering an arrangement for cleaning level control and recorder nozzles operating equipment at the Pecla plant.

Do You Remember?

From The Oil and Gas Journal Files

25 YEARS AGO

Lots of drilling is to be done this year—in the oil fields and in the newly organized Army camps.

British oil journals are still discussing that proposed trans-Atlantic subsea pipe line. The entire problem should be set aside until after the war.

It is estimated that the present potential production of Mexico is 700,000 bbl. daily. But the wells are pinched in and the daily output is not over one-seventh of this amount.

Cardinal Petroleum Co. and Choctaw Natural Gas Co. are erecting derricks and expect to commence drilling at once for oil and gas near Canadian, Okla. Howard Searcy and Five Tribes Land Co. are also building derricks in the district.

20 YEARS AGO

The Galena-Signal Oil Co. is reported to have completed arrangements for a new $500,000 plant on a 14-acre site recently acquired near Richmond, Va.

The supply of crude-oil production in the United States this year is estimated at 474,000,000 bbl., or an average of 47 bbl. for each registered motor vehicle.

Max Ball has just been elected vice president of the American Association of Petroleum Geologists for the ensuing year.

William Geiser, 76, said to have been the builder of the first pipe line in the Mid-Continent field, died at Hot Springs, Ark., where he had gone for his health.

10 YEARS AGO

Equipment manufacturers are receiving inquiries for pipe to be used in constructing the new Iraq pipe line.

The U.S.S.R. is no longer hiring oil-field and refinery workers to go abroad, according to Amtorg Trading Co.

Crude-oil production in California continues to average in excess of 500,000 bbl. per day.

Fred Jay Bedford, 63, chief engineer for the technical department of Magnolia Petroleum Co., died at Dallas, Tex.

PERRY E. LARSON, engineer for Shell Oil Co., Inc., has moved from Bristow, Okla., to Wichita Falls, Tex.

CHARLES W. ELLISON, Cushing, Okla., geologist, has joined Helmerich & Payne, Inc., drilling contractors, out of Tulsa.

BILL BLACKMAN, Barnsdall Oil Co. geologist and scout at Midland, Tex., has been transferred to Arkansas to look after the play started by the recent work at Midway.

ISHMAEL PILKINGTON, recently of Tyler, Tex., has been named to succeed B. B. BRALEY, JR., as head of the map and statistical department of Barnsdall Oil Co., Tulsa. Mr. Braley has been transferred to Texarkana, Ark.

GEORGE SCHNEIDER, of the Texas Co., at New Orleans, La., addressed a dinner meeting of the Shreveport Geological Society last week on "Discussion on the Rate of Discovery of Fields in South Louisiana."

CHARLES F. ROESER, of Roeser & Pendleton, Inc., Fort Worth, Tex., and chairman of the Texas Mid-Continent Oil and Gas Association's committee to collect scrap, has announced that a total of 28,000 long tons of scrap has been collected during the campaign. This is a total of 800 carloads.

F. E. RICE, Phillips Petroleum Co., Bartlesville, Okla., has been appointed chairman of the American Petroleum Institute's Division of Production central committee on measuring, sampling, and testing natural gas and natural gasoline. GEORGE P. BUNN, also of the Phillips company, is vice chairman.

FRED COOGAN, Sayre, Okla., oil man, was head of the resolutions committee at the state convention of Republicans last Monday.

H. H. COLLETON, formerly chief gager for Stanolind Pipe Line Co., has been promoted to district foreman for the company at Wink, Tex.

HARVEY ABSHIRE, assistant in the purchasing department of Sun Oil Co., in Tulsa, for several years, has been transferred to the Dallas, Tex., offices of the company.

JERRY JEROME has been named spokesman for the Carter Oil Co., Oklahoma Pipe Line Co., and Ajax Pipe Line Corp. golfers in Tulsa, and the group has already had some conferences on the 1942 program.

E. H. LEEMANN, formerly exploitation engineer for Shell Oil Co., Inc., at Avant and Tonkawa, Okla., has been made district exploitation engineer at the company's Pampa, Tex., offices. He succeeds F. C. BUCKWALTERS, who is now an officer at Fort Benning, Georgia.

J. A. MULL, who has been associated for the past 6 years with Republic Natural Gas Co., at Wichita, Kans., and Dallas, Tex., has resigned to open a geological office at Wichita for Superior Oil Co. of California, which is entering Kansas for the first time.

J. R. ABERNATHY, of the pipeline department, and MARSHALL BROWN, of the refinery, Lion Oil Refining Co., El Dorado, Ark., are the recipients of fine engraved 17-jewel watches with the company trade mark on the dials, for having completed 15 years of service with the company without a lost-time accident during the period.

S. MESSER, of Quaker State Oil Refining Corp., has been named president of the Venango Development Corp., which plans soon to sink the first modern mining shaft into the oil sands of Pennsylvania. Other officers named are: FOREST D. DORN, Forest Oil Co., vice president; JOHN E. SELDEN, South Penn Oil Co., secretary.

Science in His Blood

J. K. Roberts of Chicago, director of research of Standard Oil Co. of Indiana, is chairman of the Division of Petroleum Chemistry of the American Chemical Society which will hold its annual meeting at Memphis, Tenn., April 20 to 24.

J. K. ROBERTS

Mr. Roberts is of a family of scientists. He was born in Berkeley, Calif., but spent his boyhood at Lexington, Ky., where his father is still professor of agronomy at the University of Kentucky. One of his sisters is a Ph.D. in psychology and is teaching in Honolulu. His brother George is a chemical engineer employed by the M. W. Kellogg Co.

When Mr. Roberts was graduated from the University of Kentucky in 1925 with bachelor of science degree won principally in industrial chemistry, he was not satisfied with his academic attainments. He therefore went on to Massachusetts Institute of Technology to earn his master's degree in chemical engineering in June 1928. During his stay there he was progressively research assistant, research associate, and divisional director of the research laboratory of applied chemistry.

In December 1928 he entered the Standard of Indiana laboratories. Only a month later he was promoted to a position as group leader. He became an assistant director of research in the Whiting laboratory in 1934. When Bruce K. Brown was made general manager of research and development for the company in 1938 Mr. Roberts was moved to the Chicago office to assist him. Shortly thereafter he was appointed director of research, in which capacity he is serving the company today.

In 1930 Mr. Roberts was married to Marion Robb of Carroll, Iowa. They have two children, Joseph K. Jr., and George Robb, with whom they constitute a lively and happy family living in Flossmoor, Ill., near the Flossmoor Country Club, where Mr. Roberts seeks occasional surcease from the cares of research by shaking a wicked golf stick at little hard rubber balls.

RICHARD (DICK) BREWER, seismologist for Shell Oil Co., Inc., Midland, Tex., has left for an officers' training school.

FRANK DAVIS, formerly district superintendent of South Texas production, for Lion Oil Refining Co., is now located in El Dorado, Ark., as superintendent of the gas pipeline department of the company.

FREDERICK A. HOUGH, who became associated with Southern Counties Gas Co., Los Angeles, Calif., in 1925 as a chemist, has been elected a director of the company. Mr. Hough was appointed research engineer in 1928, distribution engineer in 1931, and executive engineer in 1941.

G. R. WALTON, United Gas Pipe Line Co., Houston, Tex., has announced that the A.G.A. Gas-Engine Lower Committee, Industrial and Commercial Gas Section, of which he is chairman, has mailed out the annual gas-engine census questionnaire to natural-gas companies and manufacturers of gas engines.

J. R. PARTEN, president of Woodley Petroleum Co., Houston, Tex., and who was recently made director of transportation for OPC, was appointed a member of the East Texas Chamber of Commerce committee for the annual convention of the association to be held in Longview, Tex., April 19-20.

LELAND S. HALL, formerly district manager at Amarillo, Tex., for the liquefied gas division of Phillips Petroleum Co., is now a first lieutenant of field artillery at Fort Sill, Oklahoma. His former position is now held by A. W. PECK, who was formerly assistant division manager in the Amarillo offices.

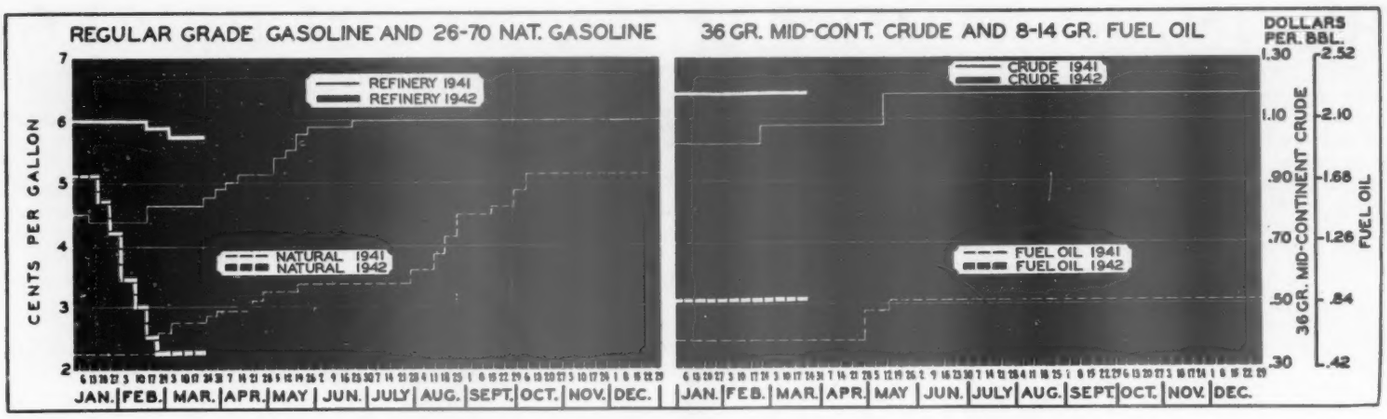
B. A. HARDEY, Shreveport, La., independent oil producer and former conservation commissioner of Louisiana, has been named chairman of the standing committee on unnecessary and unprofitable drilling for 1942 of the Independent Petroleum Association of America. R. A. KING, president, King Oil Co., Wichita, Kans., is vice chairman.

Shifts: D. N. BARROW, superintendent, Arkansas Fuel Oil Co., Waskom, Tex., to Shreveport, La.; CHARLES PRATHER, superintendent, Harbar Drilling Co., Gainesville, Tex., to Lyons, Kans; HOWARD R. GHOLSON, president, Craig-Gholson Co., Evansville, Ind., to Ranger, Tex.; H. W. KEEHN, engineer, Texas Co., El Campo to Petroleum, Tex.; B. S. WEAVER, engineer, Phillips Petroleum Co., Odessa, Tex., to Bartlesville, Okla.; T. D. TABBERT, engineer, Shell Oil Co., Inc., Pampa, Tex., to Tulsa; SLATER R. GORDON, engineer, Humble Oil & Refining Co., Crowley to Bell City, La.; DON BASSETT, superintendent, Kiowa Drilling Co., Hutchinson, Kans., to McLeansboro, Ill.; RAY DIMIT, engineer, Shell Oil Co., Inc., Tulsa to Wichita Falls, Tex.; BOB O. BIRD, superintendent, Phillips Petroleum Co., Floydada, Tex., to Oklahoma City, Okla.; L. C. BROCK, purchasing agent, Texas Pipe Line Co., Salem to Olney, Ill.; JOHN J. SEERLEY, Midland Corp., Kansas City, Mo., to Chicago, Ill.; R. P. PHILLIPS, R. P. Phillips Well Service, Jennings to Lafayette, La.; F. E. HART, superintendent, pipe-line department, Gulf Refining Co., Indianapolis to Cambridge, Ind.

J. M. H. YOUNG, superintendent of the City Gas Co. of London, London, Ont., and W. H. McKENZIE, president of the Wyandotte County Gas Co., Kansas City, Kans., have the distinction of being the only charter member of the former Natural Gas Association now actively engaged in the gas business. The first meeting of the Natural Gas Association was held in Kansas City in 1906.

W. M. GRIFFITH, vice president and general manager of Plymouth Oil Co., Sinton, Tex., and HARRY WIESS, president, Humble Oil & Refining Co., Houston, Tex., will be guests of honor at the fifth annual South Texas Oil Men's meeting, sponsored by the South Texas Chamber of Commerce, at San Antonio, Tex., next month.

JOHN C. YOUNG, a Chinese American who has been associated with the Conservation Committee of California Oil Producers since 1939, in charge of depth-pressure work, has resigned to become a first lieutenant in the ordnance department of the U. S. Army. Before entering the umpire's office, Mr. Young, a graduate of Stanford University, was employed for 2 years in the production laboratory of Standard Oil Co. of California.



MARKET DEVELOPMENTS . . .

East Coast

NEW YORK, Mar. 24.—Gasoline rationing on the WPB basis went into operation on the East Coast last week with little complaint on the part of service-station operators though it was generally believed that the present basis would be superseded by more drastic regulation later on. Since tire rationing had already reduced consumption, station operators encountered little difficulty in meeting demand. Restrictions on sales, when applied, were limited chiefly to transient customers. The effect of tire rationing has been felt most heavily during the past 6 weeks. Since gasoline rationing is based more on prior months the effect of the latter has been much less severe than generally anticipated.

The lone objection to the WPB order on the part of District 1 station operators was its failure to set specific hours for closing stations. However, this has been taken care of in most instances by the retail-gasoline associations which have adopted programs which their members will follow. Many stations were closed Sunday, a practice that virtually all are expected to follow in the future.

Freezing of service-station prices in District 1 went into effect Monday under the OPA order prohibiting an advance over prices as they existed March 13. It is possible that this forestalled at least scattered increases since price advances were posted on a wide scale when somewhat similar rationing measures were adopted last summer.

Advances in refinery tank-car prices which were requested almost 3 months ago are reported still under advisement by the OPA. Recurrent reports that such advances were to be allowed have been denied by subsequent events in each instance. Further increases in tanker transportation costs as the result of increased war-risk insurance rates plus the additional volume of oil being brought into the district by rail emphasizes the need for price adjustments that will offset the greater costs.

Mid-Continent

PURCHASING of motor fuel and burning oils in the Mid-Continent for tank-car movement to the East Coast was accelerated this week. Reports were current that approximately 30,000 tank cars have been siphoned out of the middle western territory for transportation of purchases made in the Mid-Continent and other interior refining districts during the past 3 or 4 weeks.

Statements from the OPC in Washington, D. C., indicate that approximately 10,000 tank cars have been removed from middle-western service and diverted to the East Coast. The disparity of 20,000 tank cars in Mid-Continent reports and the OPC figure is attributed to inclusion in the higher figure of equipment engaged in temporary service.

Increased shipping to the East Coast has eliminated several of the softer spots in the Mid-Continent motor-fuel market although material is still more than adequate to meet interior requirements. Mid-Continent refiners report that it is now difficult to locate sufficient tank cars to handle the interior demand and the supply situation at interior markets is suffering the blight of inadequate transportation. Demand is brisk for all grades of fuel oils, including kerosene, diesel fuels, tractor oils down through industrial burning products. Spring plowing and planting in the agricultural districts is creating higher demand for farm-tractor products. Railroads are clamoring for greater deliveries of heavy fuels as are industrial plants producing war materials in the Middle West.

Call for natural gasoline in the Mid-Continent district continues in approximate balance with production. Stocks in North Texas are increasing and are preventing improvement in the Group 3 price which is steady at 2.25 cents per gallon.

SENTENCE SUMMARIES

MID-CONTINENT: Shipments of fuel oil to East Coast increasing. All product prices steady.

GULF COAST: Rate of rise in storage checked by curtailment of crude deliveries, possibly increased loadings.

EAST COAST: Decline of stocks continues despite record tank-car deliveries.

PACIFIC COAST: Diminishing demand reflected in softer prices for gasoline. Heavy fuels firm.

PENNSYLVANIA: All products firm at unchanged prices. Refinery runs exceed production.

A.P.I. REFINERY REPORT

Week Ended March 14, 1942

(Figures in thousands of barrels)

	Dly. crude runs to stills	Stocks Gasoline	Residual	Gas oil
East Coast	502	18,043	6,292	7,700
Appalachian	145	3,914	614	362
Ind., Ill., Ky.	694	23,058	3,838	2,751
Okla., Kans., Mo.	325	10,492	1,842	838
Inland Texas	186	3,835	1,172	69
Texas Gulf	854	21,934	8,625	7,115
Louisiana Gulf	165	4,728	1,876	1,457
N. La., and Ark.	88	1,287	283	117
Rockies	91	2,513	611	307
California	538	17,425	60,336	12,115
Total Mar. 14, 1942	3,588	107,229	85,489	32,831
Total Mar. 7, 1942	3,530	106,668	87,531	33,386
Total Mar. 15, 1941	3,546	98,014	95,164	32,520

Note: Refinery runs and stocks for week ended March 21, 1942, appear on Trends page.

CRUDE-OIL STOCKS

(Bureau of Mines estimate)

Week ended:	Bbl. of crude*
March 14, 1942	262,053,000
March 7, 1942	260,064,000
March 15, 1941	264,304,000

*Excludes heavy, unrefinable crude in California.

Gulf Coast

HOUSTON, Tex., Mar. 23.—Sales of major refined products in the Gulf Coast refinery market was being slowed down due to the lack of tank cars and there is a general feeling among market observers that this situation may become more acute. Tank cars continue to be shifted inland for shorter hauls to the East Coast. Thus far, the situation has not affected prices, however. Much of the material sold is still held in storage due to the lack of transportation, and if the conditions exist much longer, there is a general feeling that there may be a tendency to shade prices.

Due to secrecy surrounding tanker movement, no information is available as to how much material is being lifted. However, most recent reports on stocks show modification in the rate of increase which indicates that there has been some improvement.

There has been little spot-market trading, and the material moved is said to have been purchased under contract. In reporting inventories as of March 15, the Gulf Coast Refiners Association placed stocks of gasolines at 2,509,401 bbl., an increase of 149,868 bbl. since March 1. Total stocks of refined products were 5,559,295 bbl., an increase of approximately 29,000 bbl. Crude runs amounted to 1,435,969 bbl., daily, an average of 95,731 bbl., or 58.5 per cent of capacity.

Fuel oils were reported in good demand with material scarce.

Pacific Coast

LOS ANGELES, Calif., Mar. 24.—The refined-oil market in California, reflecting partial rationing in two northwestern states, a surplus of stocks and diminishing demand has grown steadily softer. Gasoline is weak. Several small sales were made this week below prevailing quotations. Crude oil that was being purchased below posted prices has moved up about 5 cents per barrel but this has not been reflected in gasoline quotations. One large independent producer is without a market for current production and unless relief is given this crude it may be offered below current market prices.

Diesel and gas-oil prices continue at low levels due to an oversupply and increasing stocks.

REFINERY AND TANK-WAGON PRICES

(Prices as of March 24)

Refinery Gasoline

Octane (A.S.T.M.):	†80	78	74-76	72-74	68-70	63-66	60 & lower
Mid-Continent*	.....	.....	.....	5.625-5.875	.....	5.250-5.500	4.875-5.125
Pennsylvania	.....	.....	6.750-7.000	.....	.....	.....	.....
Gulf Coast‡	6.00-6.50	.....	.....	§5.750-6.250	§5.750-6.250	§5.250-5.750	§5.000-5.500
Northeast Coast	.....	.....	.....	8.300	8.300	.....	.....
Pacific Coast	.....	7.000-7.500	6.750-6.875	6.500-6.750	6.000-6.500	5.250-5.500	4.750-5.000

*Basis Group 3. †1939 C.F.R. (research method). ‡Integrated companies restricted to lowest prices. §Unleaded.

Quotations are f.o.b. plant in cars and in cents per gallon except where otherwise noted. They are exclusive of the federal excise taxes of 1.5 cents a gallon on gasoline and 4.5 cents a gallon on lubricating oils, and do not include marine lighterage charges.

Natural Gasoline

Grades:	26-70	18-55	75-85(350-375)
Oklahoma (Group 3)	2.250	2.625-2.750	.....
North Texas	2.000	2.375-2.500	.....
North Louisiana	2.125	2.500-2.625	.....
California	.....	.....	4.750-5.000

Kerosene and No. 1 Fuel Oil

Gravity:	46	45	42-44	41-43	38-40
Mid-Continent*	.....	.....	4.500-4.750	4.375-4.625	.....
North Louisiana	.....	.....	.....	4.500-4.750	.....
Pennsylvania	6.250	6.125-6.250	.....	.....	.....
California	.....	.....	.....	4.500-6.000	4.500
Northeast Coast	.....	.....	.....	5.300	.....
Gulf Coast	.....	.....	.....	3.875	.....

*Basis Oklahoma Group 3.

Tractor, Diesel, and Bunker Fuel Oil

Specifications:	46-48° G.	24 D.I.	48-52 D.I.	58 & above	Diesel bunkers	Bunker C
Mid-Continent*	4.125	.....	.....	.....	.....	.....
California	.....	2.750-4.000	.....	.....	‡$1.35-1.45	$0.80-0.90
Gulf Coast	.....	.....	4.000	4.125	1.45	0.85
Northeast Coast	.....	.....	.....	5.200	2.15	1.35
North Louisiana	.....	.....	.....	.....	.....	†0.80-0.85

*Basis Oklahoma Group 3. †10-14° gravity. ‡Pacific Specification 200.

Furnace Oil, Gas Oil, Fuel Oil

	No. 2	No. 3	No. 5	No. 6
Mid-Continent*	3.500-3.625	3.375-3.500	$0.85	$0.85
Pennsylvania (West)	5.625-5.875	5.375-5.875	†5.250-5.500	.....
Northeast Coast	5.2	5.2	1.65-75	1.35
Pacific Coast	5.5	5.5	†0.75-95	§0.80
Gulf Coast	3.875-4.0	.....	1.65	0.85

*Basis Oklahoma Group 3. †36-40 gravity fuel oil. ‡Pacific Specification 300. §Pacific Specification 400.

Lubricating Oils

Bright and Steam Refined

OKLAHOMA (Group 3)—		
200-210 D, 10-25		27.00
150-160 D, 0-10		23.00
120-125 D, 0-10		22.00
Steam refined:		
600 dark green (untreated)	9.00	9.50
PENNSYLVANIA—		
Bright Stocks (Pennsylvania Grade No. 8 color, 140-150 at 210, 545-550 flash):		
10 pour point		30.50
15 pour point		29.50
25 pour point	25.00	28.00
Steam refined:		
600	15.00	16.00
650	15.50	16.50
600 flash	16.00	17.50
630 flash	17.00	17.50

Neutral Oil

(Vis. at 100° F. except Pennsylvania and color N.G.A.)

OKLAHOMA (Group 3)—	
0-10 pour point:	
200-3	15.00
300-3	18.00
500-3	19.50
600-3	20.00

Note: Viscous neutrals, 10-25 pour, quoted 0.5 cent under 0-10 oils.

Wax

(Cents per pound)

OKLAHOMA (Group 3)—	
124-126 (A.m.p.) w.c. scale	4.350-4.550
PENNSYLVANIA (inland refineries)—	
122-124 (A.m.p.) w.c. scale	4.250
124-126 (A.m.p.) w.c. scale	4.250

Neutral Oil

CALIFORNIA—		
Pale oils:		
200-2½-3	7.00	7.75
400-3-4	7.25	8.00
600-3-4	8.75	11.00
Red oils:		
200-4-5	7.00	7.75
400-5-6	9.00	11.00
500-900, 5-6½	9.25	11.25
GULF COAST—		
Pale oils:		
200-3	8.50	8.75
300-3	9.00	9.25
500-3½	9.75	10.00
750-3½	10.00	10.25
2,000-4	10.50	10.75
3,000-4	12.25	12.50
PENNSYLVANIA—		
150 vis. at 70° F., 3 color, 400-405 flash:		
Zero pour point		38.50
10 pour point		37.50
15 pour point		36.50
25 pour point		31.00
200 vis., at 70° F., 3 color:		
Zero pour point		40.50
10 pour point		39.50
15 pour point		38.50
25 pour point		33.00
NEW YORK—		
Wax in bags fully refined:		
130-132 (A.m.p.) wax		6.250
133-135 (A.m.p.) wax		6.550
Crude scale:		
124-126 (A.m.p) w.s.		4.350-4.455
124-126 (A.m.p.) y.s.		4.350-4.455

EXPORT PRICES

Gasoline—60-62° Gravity, Maximum 400 End Point

Octane:	72-74	68-70	65-66	60
Gulf Coast	6.500	6.250-6.500	5.875	5.625
Pacific Coast	.....	6.125-6.500	5.875-6.000	5.500-5.625

Distillate and Fuel Oil

	Kerosene	Diesel fuel			Bunker
	41-43	24 G.	48-52 D.I.	58 D.I. Bunkers	C grade
Gulf Coast	4.000-4.250	.....	4.125-4.375	4.375 $1.65-80	$0.85-95
Pacific Coast	4.750-5.000	1.25-30	.....	..... †1.35-45	*0.80-90

*Pacific Specification 400. †Pacific Specification 200.

Lubricating Oils

	Neutral oils		Bright and cylinder stocks		
	200-3	150-3	200-3	150-3	600&630 S.R.
Mid-Continent	16.8		28.8	24.8	.....
Pennsylvania	43-50	41-46	36-37	36-37	26.5-27

GASOLINE AND KEROSENE TANK-WAGON PRICES IN 50 CITIES

(Gasoline prices based on regular grades, tax included, undivided dealer)

ATLANTIC AND NEW ENGLAND

(Socony-Vacuum Oil Co., Inc., and Atlantic Refining Co.)

	Dealer tank wagon	Combined tax	Kero-tank wag.
Baltimore, Md.	14.55	5.50	8.70
Boston, Mass.	14.00	4.50	8.00
Burlington, Vt.	16.00	5.50	...
Buffalo, N. Y.	15.30	5.50	8.80
Dover, Del.	15.80	5.50	10.50
Hartford, Conn.	14.70	4.50	...
Manchester, N. H.	16.40	5.50	9.00
Newark, N. J.	13.80	4.50	7.90
New York, N. Y.	15.20	5.50	8.00
Philadelphia, Pa.	15.30	5.50	10.15
Pittsburgh, Pa.	15.80	5.50	10.50
Portland, Me.	15.40	5.50	8.10
Providence, R. I.	14.10	4.50	7.80
Washington, D. C.	13.80	3.50	9.20
Average 14 cities	15.07	5.07	8.89

(All prices undivided dealer basis.)

CENTRAL

(Standard Oil Co. of Indiana, Standard Oil Co. of Ohio, Continental Oil Co. and Texas Co.)

	Dealer tank wagon	Combined tax	Kero-tank wag.
Chicago, Ill.	14.10	4.50	10.30
Cleveland, Ohio	15.00	5.50	*9.00
Dallas, Tex.	13.00	5.50	7.00
Des Moines, Iowa	11.90	4.50	9.80
Detroit, Mich.	14.40	4.50	9.60
Fargo, N. D.	16.90	5.50	11.30
Huron, S. D.	16.30	5.50	10.70
Indianapolis, Ind.	15.20	5.50	9.80
Little Rock, Ark.	17.50	8.00	10.00
Milwaukee, Wis.	16.10	5.50	10.50
Minneapolis, Minn.	15.40	5.50	10.30
Omaha, Neb.	15.40	6.50	9.80
Tulsa, Okla.	16.50	7.00	8.50
Wichita, Kans.	12.70	4.50	8.00
Average 14 cities	15.03	5.57	9.61

*Includes 1-cent state tax.

SOUTHEASTERN

(Standard Oil Companies of New Jersey, Kentucky and Louisiana)

	Dealer tank wagon	Combined tax	Kero-tank wag.
Atlanta, Ga.	18.50	7.50	9.00
Birmingham, Ala.	19.60	8.50	9.00
Charleston, S. C.	18.05	7.50	...
Charleston, W. Va.	18.35	6.50	11.50
Charlotte, N. C.	19.20	7.50	9.50
Jacksonville, Fla.	18.50	8.50	8.00
Jackson, Miss.	18.00	7.50	8.50
Louisville, Ky.	17.00	6.50	8.50
Memphis, Tenn.	17.75	8.50	10.50
New Orleans, La.	17.25	8.50	*10.00
Norfolk, Va.	16.55	6.50	10.20
Average 11 cities	18.07	7.59	9.47

*Includes 1-cent state tax.

MIDWESTERN

(Continental Oil Co.)

	Dealer tank wagon	Combined tax	Kero-tank wag.
Albuquerque, N. M.	17.50	7.50	10.00
Boise, Idaho	20.10	6.50	16.50
Casper, Wyo.	17.00	5.50	12.00
Denver, Colo.	14.50	5.50	11.00
Helena, Mont.	17.00	6.50	13.00
Phoenix, Ariz.	18.50	6.50	12.50
Reno, Nev.	17.50	5.50	13.50
Salt Lake, Utah	18.50	6.50	14.50
Average 8 cities	17.58	6.25	12.88

PACIFIC COAST

(Standard Oil Co. of California)

	Dealer tank wagon	Combined tax	Kero-tank wag.
Portland, Ore.	17.00	6.50	13.50
San Francisco, Calif.	14.50	4.50	11.50
Seattle, Wash.	17.00	6.50	13.50
Average 3 cities	16.17	5.83	12.83
Average 50 cities	16.17	5.96	10.15
Average last week	16.14	5.96	9.87

Canadian Fields

(Continued from Page 279)

current allowable of 501 bbl. daily, and it is thought possible a prolific area similar to the new North Turner Valley extension may be opened to the southwest.

Grease Creek Drilling

On the Grease Creek structure, in the foothills northwest of Calgary, Grease Creek-Northwest 2, LSD 7. 13-29-7w5, is below 7,401 ft. and deep ening. The Madison lime, the potential producing horizon, was expected at 7,500 ft., but recent cores have shown blue shale, which may be a recurrence of the overlying Benton. Drilling will be continued in any event till the formation is defined.

New Brunswick Shale

The gasoline shortage has drawn attention to the possibility of extracting oil from extensive shale deposits in Albert County, New Brunswick. At one time shales from both New Brunswick and Nova Scotia were extensively mined, and processed, not merely in local plants, but in distillation plants in the Atlantic States: but the product was unable to compete with petroleum from drilled wells. The Alberta shales yielded as high as 100 gal. to the ton, and the available deposits are estimated at millions of tons.

Crude-Oil Prices

(Complete crude-price tables are published in the first issue of each month.)

Representative selected crude prices from all sections of the country appear below:

East Texas	$1.25
Conroe	1.43
Tepetate, Louisiana	1.18
Smackover, Arkansas, heavy	.83
Illinois basin	1.37
Pecos County, Texas	.95
Lance Creek, Wyoming	1.12
Bradford, Pennsylvania	2.75

Gravity Schedules

Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

Gravity	Signal Hill, Calif.	Oklahoma, Kansas	Gulf Coast, Texas	West Texas*
18-18.9	$0.80	...	...	...
19-19.9	.84	...	$1.06	$0.70
20-20.9	.88	$0.85	1.08	.72
21-21.9	.92	.87	1.10	.74
22-22.9	.96	.89	1.12	.76
23-23.9	1.00	.91	1.14	.78
24-24.9	1.03	.93	1.16	.80
25-25.9	1.07	.95	1.18	.82
26-26.9	1.11	.97	1.20	.84
27-27.9	1.15	.99	1.22	.86
28-28.9	1.18	1.01	1.24	.88
29-29.9	1.20	1.03	1.26	.90
30-30.9	1.23	1.05	1.28	.92
31-31.9	...	1.07	1.30	.94
32-32.9	...	1.09	1.32	.96
33-33.9	...	1.11	1.34	.98
34-34.9	...	1.13	1.36	1.00
35-35.9	...	1.15	1.38	1.02
36-36.9	...	1.17	1.40	1.04
37-37.9	...	1.19	1.42	1.06
38-38.9	...	1.21	1.44	1.08
39-39.9	...	1.23	1.46	1.10
40 and above	...	1.25	1.48	1.12

*Includes Lea County, New Mexico.

PRACTICAL DATA FOR PRESENT PROBLEMS

Here are two books designed to help users of Molybdenum steels and irons to conserve all alloying elements, and possibly steel and iron, by getting the most in the way of strength, toughness and wear resistance with the lowest alloy content.

"MOLYBDENUM IN STEEL" covers the fundamental metallurgy of Molybdenum steels. Heat treatment – physical properties – applications – of a number of these steels are treated at length.

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MOLY

EQUIPMENT PROGRESS...

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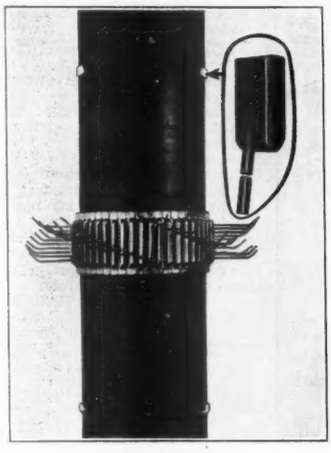

B and W, Inc., Houston, Tex., and Long Beach, Calif., announces the development of welding blocks for B and W wall-cleaning guide installations to speed up the casing operation.

The blocks are spaced 14 in. apart vertically, and are welded to the casing to restrict the travel of the wall-cleaning guides, but still allow sufficient travel to release the slips without scratching as each joint is run. The blocks are $\frac{1}{4}$ in. by $\frac{5}{8}$ in. by $\frac{3}{4}$ in. and have a wire handle which is cut off with the arc as each block is welded to the casing.

The guides are packed three to the carton, and six welding blocks per guide are furnished.

Norton Is Awarded Navy "E" For Production Achievement

The Norton Co., Worcester, Mass., manufacturer of grinding machines, grinding wheels, and other abrasive products, has been presented the U. S. Navy "E" award for meritorious production achievement for the Navy and Government. The presentation was made formally at appropriate ceremonies at the Norton field house March 23 by Admiral Wat Tyler Cluverius, representing Secretary of the Navy Frank Knox. The award, a large Navy "E" pennant to be flown over the company's plant, was accepted by George N. Jeppson, president of the company. Navy "E" lapel buttons for employes were presented by Mayor William A. Bennett of Worcester, and were accepted in behalf of the employes by P. Joel Styffe for workers of the abrasive division, and Leonard R. Cutler for workers of the machine division.

TRADE LITERATURE

MORSE CHAIN CO., 7601 Central Avenue, Detroit, Mich.—Six-page "Indexing and Free-Wheeling Clutch Bulletin," No. K-6, covering clutch applications for indexing, free-wheeling, and back-stop operations. It contains much engineering data with diagrams and charts, and is well illustrated.

WORTHINGTON PUMP & MACHINERY CORP., Harrison, N. J.—Bulletin L-710-B1, 8-page pamphlet, describing Worthington single-stage and two-stage, horizontal dry vacuum pumps, equipped with feather valves and tapered roller bearings. Also, Bulletin W-205 B9, 8-page pamphlet, describing three-stage steam-jet ejectors, their developments and applications. Also, Bulletin H-620-B16F, describing Types V2A2, V3A2, and V6A2, two-stage radial air compressors.

THE BABCOCK & WILCOX TUBE CO., Beaver Falls, Pa.—A new, convenient Technical Data Card, No. TDC-115, giving a complete table of tolerances for round, seamless-steel, mechanical tubing for both cold-drawn and hot-finished tubes. Requests should be made on company letter heads.

AMONG EQUIPMENT MEN

General Electric Promotes Managers of Two Districts

W. B. Clayton, district manager, General Electric Co., Dallas, Tex., has been elected commercial vice president, Charles E. Wilson, president of the company at Schenectady, N. Y., has announced. Also elected to the same office was T. F. Barton, district manager, New York, N. Y. Both men will continue as district managers of their respective territories.

W. B. CLAYTON

Mr. Clayton has been district manager at Dallas since November 1939. He went to Dallas in 1911 with the Southwest General Electric Co., and when the southwestern district was formed in January 1924, was made district manager of the central station department. In 1929, he assumed the additional duties of assistant district manager. He has been associated with General Electric Co. since 1905, going to work as a student engineer following his graduation from Alabama Polytechnic Institute when 17 years old. Shortly after, he entered the testing department of the company at Schenectady, where he remained 3 years.

Mr. Clayton is a native of Brooklyn, N. Y. He served in the first World War as a captain. He is a member of the North Texas section of the American Institute of Electrical Engineers and first vice president of the Dallas Electric Club, and also is associated with many community and civic organizations and activities.

Westinghouse Makes Kersh Manager of Houston Office

Robinson S. Kersh, industrial sales engineer, has been appointed manager of the Houston, Tex., office of the Westinghouse Electric & Manufacturing Co., according to C. E. Allen, southwestern district manager.

Joining the Westinghouse graduate-student course in July 1929, Mr. Kersh was given experience in various headquarters sales sections before being transferred in 1931 to the Atlanta, Ga., sales office. Later the same year he was assigned to Birmingham, Ala., and remained at that office until 1938 when he moved to the machinery electrification and aviation section at East Pittsburgh, Pa. He served in this section until his present appointment.

Born in Pelahatchie, Miss., in 1908, Mr. Kersh attended high school at Jackson, Miss., and was graduated from Mississippi State College in 1929 with a degree in electrical engineering. At college he was president of the student chapter, American Institute of Electrical Engineering, and a member of Tau Beta Pi, honorary engineering fraternity.

Browning Succeeds Rader As Kobe Division Manager

Kobe, Inc., announces the appointment of H. K. Browning as division manager in charge of the company's Mid-Continent activities, replacing C. M. Rader who recently was made general sales manager with headquarters in Huntington Park, Calif. Prior to this appointment, he was division sales manager. In his new position he will have charge of all advertising and promotion efforts in connection with the company's products.

H. K. BROWNING

Mr. Browning attended Cornell University's school of engineering. Later he became associated with A. M. Byers Co., Pittsburgh, Pa., where he was active in technical sales work, holding the position of manager of oil-country sales at the time he left the company. Interest in pumping and corrosion problems led to his connection in 1934 with S. M. Jones Co., as sales manager, a position he filled for 5 years. He joined Kobe, Inc., in 1940.

Mr. Browning's appointment was effective March 1, and he will retain headquarters in the company's division offices at Oklahoma City, Okla.

Fitzpatrick and Tyer Given Promotions by Continental

W. G. Fitzpatrick, manager of sales, Continental Supply Co., Dallas, Tex., has been appointed district manager, Houston, Tex., and E. E. Tyer, now sales representative, Houston, has been advanced to assistant district manager. Mr. Fitzpatrick succeeds F. H. Thrailkill, retired.

W. G. FITZPATRICK

Mr. Fitzpatrick has had an extensive career in the oil-well supply business. After studying engineering at Carnegie Institute of Technology, Pittsburgh, Pa., he served as a commissioned officer in the U. S. Marine Corps during World War I. From 1919 to 1928 he was associated with the National Supply Co. He then joined the sales staff of Emsco Derrick & Equipment Co., Houston, and subsequently was promoted to sales manager in charge of Emsco activities in the Mid-Continent. In 1933 he became a sales representative for the Continental Supply Co., with headquarters in Houston. In 1939 he was made manager of sales with headquarters in Dallas, where he served until his present appointment.

E. E. TYER

Mr. Tyer's oil-field experience dates to 1919 with the Standard Oil Co. of Louisiana in northern Louisiana where he started after serving 18 months in World War I. From 1919 until 1931 he was with Oil Well Supply Co., as manager at Shreveport, La. He later was appointed district manager at Shreveport and subsequently at Houston.

He joined the Continental Supply Co. in 1931 and has been serving in Houston since then.

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Inquiries Invited
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OIL PROPERTIES EXCHANGE
For Sale: Many Producing Oil Properties, Royalties, Drilling Blocks, and Oil Investments of various sizes in Mid-Continent area. Contact us to Buy or Sell properties
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WATCH GEORGIA
For information write C. W. Deming, Registered Dealer, Waycross, Ga.

EAST TEXAS 9,000 ft. Paluxy-Trinity sand wildcat. Quick bet for 10 to 50 for one. E. CROFT, PROCTOR, TEXAS.

CENTRAL NEBRASKA
FOR SALE: Oil and Gas leases—Royalties, on proven structures by core drill—also unproven acreage. Loup Valleys Royalty Co., Loup City, Nebraska.

CHEAP CRANE COUNTY Sec. 18, B28, under Magnolia-Stanolind leases. Jefferson G. Smith, 215 Littlefield Bldg., Austin, Tex.

FOR SALE: Two oil leases with 4 and 17 wells; these leases offer a real water flooding opportunity; shallow drilling. H. W. Mitchell, Osawatomie, Kans.

WILL give 2000 A. for a test well near a large gas field, if you drill at once. No rentals. One well will hold the block for a 1/16 override. John Gerhardt, New Berlin, Ill.

FREE, block of 3,000 acres Lease to driller or company for drilling a well in Grant Co., Ark., where 20 years ago oil was struck, only carelessness and lack of capital stopped bringing up the new oil field. For further information write to V. Herodes, 1534 S. Pulaski Rd., Chicago, Ill.

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Financing

CAPITAL SEEKERS—Interested in raising $25,000 or more for a legitimate project should communicate with AMSTER LEONARD, Fox Theater Bldg., Detroit, Mich.

OUT OF 5000 American financial houses only 223 bought small issues last few years. The 223 names $4.00. JOHN F MORRIS, Box 5411, Philadelphia.

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GASOLINE Plant Superintendent: 15 years' experience in all phases plant operation and maintenance, best of references, available immediately. Box A-923, The Oil and Gas Journal, Tulsa, Okla.

REFINERY Engineer, 5 years' experience in operation, maintenance of thermal and catalytic cracking equipment, process control, design, and general plant engineering. Box A-922, The Oil and Gas Journal, Tulsa, Okla.

PETROLEUM ACCOUNTANT—Full responsibility corporation, partnership, individual firms, seven years with each. All financial reports, state and federal production and tax reports, income tax returns. Above firms engaged in drilling and producing. Desires change. Wife and one child totally dependent. References. Box A-921, The Oil and Gas Journal, Tulsa, Okla.

A FORMER drilling contractor wishes position as supervisor of tools or production, "can produce," thoroughly familiar with all branches of production, experienced in deep drilling and extreme high pressures, will go anywhere. Box A-920, The Oil and Gas Journal, Tulsa, Okla.

EXECUTIVE with twenty-five years' experience in the producing and land departments, part of this time as executive vice president of major Independent company which was merged with a major company, desires connection independent company or parties with money to invest in the oil business as there are many opportunities in the southwest country to make money. Box A-902, The Oil and Gas Journal, Tulsa, Okla.

PETROLEUM and Natural Gas and Chemical Engineer desires change. Sixteen years' experience plant operation and testing light petroleum hydrocarbons. Technical training and experience should have value for synthetic processes or by-products. Age 41 years. Ten dependents. Box A-930, The Oil and Gas Journal, Tulsa, Okla.

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Excellent opportunities for several capable oil refinery engineers, with old established engineering concern. Should have technical education, with a thorough knowledge of refinery equipment and processes. Salary commensurate with experience and capabilities.

Application should be made by letter, giving age, nationality, concise outline of previous business experience and educational background, present salary, salary desired and references. Include recent photograph. Ernest Owen, E. B. BADGER & SONS COMPANY, 75 Pitts St., Boston, Mass.

Equipment Wanted

A NUMBER of 55,000 barrel tanks. Give complete dimensions, weights and specifications: also prices as is and if possible dismantled f.o.b. with pieces numbered and diagrammed. Also interested in other sizes. Box A-891, The Oil and Gas Journal, Tulsa, Okla.

WANTED: Light steam rotary rig. Send list and price and location. Box 164, Newton, Illinois.

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Incorporation

DELAWARE CHARTERS: Complete service $35. Submitted forms. Chas. G. Guyer, Inc., Wilmington, Delaware.

For Sale—Equipment

FOR SALE: 6 x 16 Wilson-Snyder Power Slush Pump. Melton Supply Co., Seminole, Okla.

FOR SALE: Near Barnsdall, Okla., one 30" x 30" 12-tray "Tulsa" Absorber, capacity 1¼ M. gas, 30#, $350.00. Patridge, Cities Service Oil Co., Bartlesville, Okla.

1—Complete Big Diesel full electric, direct current rig.
1—Medium size Direct current full electric rig.
4—Rebuilt 120 HP Diesel engines.
1—Rebuilt 200 HP Diesel Engine.
1—Small steam rig.
1—Late Model "S" Cardwell Rig complete. Made 7 holes, same as new and equipped with 6,000 feet of 3½" full hole drill pipe which has made three holes.
3—300# W.P. Boilers, A-1 Condition.
1—200 HP Diesel engine with 125 KW Generator set and switchboard.
Also stock of new engines.
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1—4000' Power Rig complete with Drilling Derrick and all necessary tools. Same in A-1 Condition. Write 924 Giddens-Lane Bldg. or Phone 2-0787, Shreveport, La.

FOR SALE: Wilson-Mogul Drawworks with water cooled brakes and 100 H.P. International Motor. Melton Supply Co., Seminole, Oklahoma.

FOR SALE: Two Byron Jackson 4 stage line pumps with 150 h.p. 1800 rpm GE. KTP 549 440 volt motors and starters, for 300 gpm 300# or 400 gpm 250# ready for service. A 1000 gpm 90 feet Dayton-Dowd 50 h.p. motor driven centrifugal. Two belted 2-stage air compressors of 340 and 368 cu. ft. disp., 120# w.p. Bruce-MacBeth engine driven 50 kw, 220 volt generator.
CORKEN PUMP & MACHINERY COMPANY
206 E. Grand Ave., Oklahoma City, Okla.

FOR SALE: Hedges-Walsh-Weidner-Scotch Marine Type Boilers, Complete. 6—150 H.P. 150# W.P. New Style API Code. 5—100 H.P. 150# W.P. New Style API Code. 1—156' x 40' x 11' Truscon All Steel Building. Bourland Supply Co., Pampa, Texas. Tel. 355.

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FOR SALE: 5½ heavy duty Keystone spudder, complete with tools from 15½ inch down, drilling and sand lines. D. L. WILLIAMS, 723 S. Broadview, Wichita, Kansas. Phone 3-6536.

FOR SALE
1—String 7" Casing @ 90c per ft.
1—String ⅞" Sucker Rods @ 13½c per ft.
2" Line Pipe @ 10c per ft.
3" Line Pipe @ 20c per ft.
1—String 2½" Upset Seamless Tubing @ 33c per ft.
And many other items of equipment useful for producers. The above quotations F.O.B. Texarkana, Arkansas and subject to prior sale. Write or phone the Union Petroleum Company at P. O. Box 826 or phone 2798-W. Office is located at 202 Presbyterian Building, Texarkana, Texas.

Two 80 H.P. Clark Compressors complete in excellent condition. $2,000.00 each. On lease at Albion, Illinois.
GEORGE B. SWINGLE
Sentinel Building Phone 549
Centralia, Illinois.

ABSORBERS
2—72" x 30' Southwestern Make 16 trays 75# W.P.
HIGH Pressure Absorber, 30" x 34' 0". 450-lb. test, Tulsa Type, 16 trays and 3 mist extractors. Will furnish complete drawings and specifications. W. S. Smith, 523 Thompson Bldg., Phone 2-5473, Tulsa.

POWER RIG COMPLETE
Capacity for drilling to 6000'. Now in Kansas. Write 302 Commercial National Bank Building, Phone 3-8601, Shreveport, La.

PRESSURE VESSELS—CONDENSERS—COMPLETE CRACKING FURNACE

2—5′ 3″ OD x 45′ x 5 3/16″ THICK REACTION CHAMBER, ONE PIECE
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SONKEN-GALAMBA SUPPLY COMPANY

W. C. Berry or H. J. Galamba
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NOW BEING OFFERED FOR SALE, ALL OR ANY PART COMPLETE 2000 BBL. TOPPING PLANT, 47 STORAGE TANKS, PERCO TREATING PLANT, CARLOAD ETHYL PLANT, HEAT EXCHANGERS, ALL HAVE BEEN RETUBED OR TUBES CUT AND READY FOR INSTALLATION, 5 TRUCK TRANSPORTS

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25 K.W. and 40 K.W. Gas Engines, 220 volts. D.C. Two 100 K.W. Gas Engine-Generator Sets, 220 volts, D.C. 7x6 Ingersoll-Rand ER-1 Air Compressor. Six-inch Oster Pipe Threading Machine. Also large stock of lathes, pipe machines, milling machines, etc. Send for our list.
Terms to suit.
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26 West 2nd St., Cincinnati, Ohio

FOR SALE at Bartlesville: 15 oak drafting tables, $35 each. Patridge, Cities Service Oil Co., Bartlesville, Okla.

FOR SALE: 125 H.P. 200 W.P. Brooderick Boiler, Code Condition, $975. Melton Supply Co., Seminole, Okla.

FOR SALE
OIL STORAGE TANKS

1—10,500 Bbl.
2—10,000 Bbl.
3— 5,000 Bbl.
4— 2,500 Bbl.
3— 1,000 Bbl.
1— 600 Bbl.
1— 100 Bbl.
2— 1,200 Bbl. Agitators.

Can be inspected at
Middlesex Refinery Co.
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DULIEN STEEL PRODUCTS, INC.
2280 Woolworth Bldg.
New York, N. Y.
Tele—Cort. 7-4676

FOR SALE: 1 Ft. Worth Spudder, 2500 ft. capacity, and 1 Star Spudder, 4,000 ft. capacity. Both machines now drilling out of Tulsa. O. B. Hausam, 4203 S. Madison, Tulsa. Phone 4-4288.

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FOR SALE: Pressure Vessels handling 100 pounds working pressure 8′ diameters 31′ 8″ lengths. Rectangular tanks, capacity 25,000 gallons and 40,000 gallons each. 26 tons I beams one carload, 12-inch I beams 13′ 2″ long. 36-inch I beams in 22. 36, 38 foot lengths. I beams $61.00 ton, f.o.b. here, approx. 27 tons. Shipments made same day purchased. HARVEY BROS., 706 Rudd, Canon City, Colo.

For Sale: Two complete power drilling rigs—one a Caterpillar Diesel. The other a Wilson Giant with 450 horsepower Le Rois. Priced reasonable.

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35 H.P. Superior Gas Engine and 16 foot Band Wheel Power. Condition A-1. The Geo. McGinley Supply Co., Bowling Green, Kentucky.

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TRACTORS
Caterpillar, crawler type, size "35" $495; size "65" with nigger head winch $895; Austin Western hydraulic grader 10′ blade $650. O. C. Evans, Mt. Sterling, Kentucky.

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20,000′ 12¾″ O.D. lapweld pipe.
5,000′ 7″, 24 lb. seamless casing.
5,000′ 2½″ seamless upset tubing.
300 sets 3″ tool joints, full hole.
200 sets 3″ full hole tool joints.
Both steam and power drilling rig A complete line of drilling and pumping equipment.

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60 day tryout on once run ⅞″ alloyed Oklahoma City second hand sucker rods to reliable operators in 10,000 foot lots. Your use of them subject to the approval of my engineer. Rods in A-1 condition. Price about half of new.
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⅞″ SUCKER Rods suitable for bolts and reinforcing. Oklahoma City district.
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For Sale: Two 60 H.P. Bruce-McBeth gas engines, like new.
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2 new Jensen Bros. pumping units, size 12-D, cable type with 2 Allis-Chalmers Model B-15 power units, Ensign combination butane, natural gas, gasoline carburetors complete. Were never used.
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4—320 HP Babcock & Wilcox Stirling type water tube boilers, Class S No. 16 with oil burners, 304 3¼″ OD boiler tubes. Last insurance inspection Jan., 1940 approved for 150 lbs. working pressure. One complete set of new tubes for one boiler.

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2—Fairbanks-Morse centrifugal water pumps, 2 stage, driven by Kerr turbines, 25 HP, size 3A, 3,000 RPM.

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3—11 x 20 Clark cylinders
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4—14 x 14 I.R. cylinders
1—100 H.P. Superior D.C. gas engine compressor
2—Sullivan Angle 1300 foot, 125#, 2-stage compressors.

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Engines—Compressors—Refining Equipment.
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FOR SALE: 1—#25 Southwestern Distillation Unit completely overhauled with or without pumps and absorber, will make 5,000 gal. gasoline per day. W. S. Smith, 523 Thompson Bldg., Tulsa, Okla., Phone 2-5473.

FOR SALE: 1 Askenia Type Magnetometer #7970, $750.00. Cities Service Oil Co., Bartlesville, Okla.—H. D. Patridge.

WRECKING 50 steel derricks. Material for Sale—3″ pipe rig legs—10″ I-beam—& 20,000′ of 1″ brace pipe. Galoob Iron & Metal Co., Box 372, Healdton, Okla.

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40 Class III 8000 gallon cars all modern improvements built 1919-20 first class condition, also 18 class II gallon cars mostly built 1914-17 in good operating condition. All cars in daily operation in West. Write Box 1213, Great Falls, Montana.

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FOR SALE: 1 Motor driven rotary drilling rig; suitable for 6,000 ft. work. Melton Supply Co., Seminole, Oklahoma.

FOR SALE: One, Type 40, 45 HP single Cooper-Bessemer Unit less Compressor Cylinder, near Madison, Kansas. $250.00. Cities Service Oil Co., Bartlesville, Okla., H. D. Patridge.

FOR SALE near Wewoka, Oklahoma: 2—80 H.P. Type V Foos Gas Engines complete in good operating condition. Patridge, Cities Service Oil, Bartlesville, Okla.

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Excellent Condition

NATURAL GAS ENGINES AND COMPRESSORS

3 — 13 x 16
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TYPE G — 16
Easily converted for — Diesel —

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For Sale: Many Producing Oil Properties. Royalties, Drilling Blocks, and Oil Investments of various sizes in Mid-Continent area. Contact us to Buy or Sell properties
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WILL give 2000 A. for a test well near a large gas field, if you drill at once. No rentals. One well will hold the block for a 1/16 override. John Gerhardt, New Berlin, Ill.

FREE, block of 3,000 acres Lease to driller or company for drilling a well in Grant Co., Ark., where 20 years ago oil was struck, only carelessness and lack of capital stopped bringing up the new oil field. For further information write to V. Herodes, 1534 S. Pulaski Rd., Chicago, Ill.

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REFINERY Engineer, 5 years' experience in operation, maintenance of thermal and catalytic cracking equipment, process control, design, and general plant engineering. Box A-922, The Oil and Gas Journal, Tulsa, Okla.

PETROLEUM ACCOUNTANT—Full responsibility corporation, partnership, individual firms, seven years with each. All financial reports, state and federal production and tax reports, income tax returns. Above firms engaged in drilling and producing. Desires change. Wife and one child totally dependent. References. Box A-921, The Oil and Gas Journal, Tulsa, Okla.

A FORMER drilling contractor wishes position as supervisor of tools or production, "can produce," thoroughly familiar with all branches of production, experienced in deep drilling and extreme high pressures, will go anywhere. Box A-920, The Oil and Gas Journal, Tulsa, Okla.

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Engineers & Contractors
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Excellent opportunities for several capable oil refinery engineers, with old established engineering concern. Should have technical education, with a thorough knowledge of refinery equipment and processes. Salary commensurate with experience and capabilities.

Application should be made by letter, giving age, nationality, concise outline of previous business experience and educational background, present salary, salary desired and references. Include recent photograph. Ernest Owen, E. B. BADGER & SONS COMPANY, 75 Pitts St., Boston, Mass.

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Regardless of condition
Get up on present prices!
This may be the time to liquidate them!
Quotations cheerfully made without obligation
IRON & STEEL PRODUCTS, INC.
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"ANYTHING containing IRON or STEEL"

1—10' diameter tower either 25' or 30' long, ⅝" or ¾" thick. Steel must be in first-class condition. Fred Grey, PanAmerican Petroleum Corp., Destrehan, La.

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2—5′ 3″ OD x 45′ x 5 3/16″ THICK REACTION CHAMBER, ONE PIECE

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8—GRISCOMB-RUSSELL SECTIONS, TYPE C-240, X-240, E-240, 1″ OD ADMIRALTY TUBES, 20′ LONG, 18 GAUGE

86—4″ OD x 3″ ID x 21′ 6″ LONG STILL TUBES, CRACKING

126—4″ OD KEY HEADERS FOR CRACKING FURNACE

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25 K.W. and 40 K.W. Gas Engines, 220 volts. D.C. Two 100 K.W. Gas Engine-Generator Sets, 220 volts, D.C. 7x6 Ingersoll-Rand ER-1 Air Compressor. Six-inch Oster Pipe Threading Machine. Also large stock of lathes, pipe machines, milling machines, etc. Send for our list.

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FOR SALE: 1 Ft. Worth Spudder, 2500 ft. capacity, and 1 Star Spudder, 4,000 ft. capacity. Both machines now drilling out of Tulsa. O. B. Hausam, 4203 S. Madison, Tulsa. Phone 4-4288.

FOR SALE at Oklahoma City: 1—100 H.P. Kewanee 200# W.P. oil field type boiler. Patridge, Cities Service Oil Co. Bartlesville, Okla.

FOR SALE: Pressure Vessels handling 100 pounds working pressure 8′ diameters 31′ 8″ lengths. Rectangular tanks, capacity 25,000 gallons and 40,000 gallons each. 26 tons I beams one carload. 12-inch I beams 13′ 2″ long. 36-inch I beams in 22. 36, 38 foot lengths. I beams $61.00 ton, f.o.b. here, approx. 27 tons. Shipments made same day purchased. HARVEY BROS., 706 Rudd, Canon City, Colo.

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ADVERTISERS IN THIS ISSUE

Air Reduction Sales Co. 6
Alco Products Division of American Locomotive Company 26
Alcorn Combustion Co. 112
Allied Steel Products Corp. 276
American Abrasive Metals Co. B25-B46
American Iron & Machine Works 263
American Meter Company 50
American Recording Chart Co. B42
American Rolling Mill Co., The 262
American Steel & Wire Co. 20-21
Anchor Burner Co. B6
Armstrong Machine Works 30
Arrowhead Iron Works B25
Attapulgus Clay Co. B3-B21
Axelson Mfg. Co. 273
B. and W., Inc. 272
Babcock & Wilcox Tube Company, The B64
Badger & Sons Co., E. B. 46-47-B29
Baldwin-Duckworth Division of Chain Belt Company 8
Bantam Bearings Corp. 4
Baroid Sales Division, National Lead Company 267
Bethlehem Steel Co. 1
Bigelow-Liptak Corp. B2-B21-B62
Black, Sivalls & Bryson B26-B44-B61
Braden Steel Corp. 131
Briggs Clarifier Co. B18
Broderick & Bascom Rope Co. 5
Brown Instrument Co., The 42-43
Buffalo Meter Co. B32
Butler Manufacturing Co. 27
Carey Company, The Philip 49
Caterpillar Tractor Co. 12-13
Century Electric Company 23
Chapman Valve Mfg. Co., The 40
Chicago Bridge & Iron Company 146-147-B49
Chiksan Tool Co. B29
Clark Bros. Co., Inc. 108-109
Classified Advertising 286-287
Climax Molybdenum Company 284
Coffing Hoist Co. 274
Consolidated Chemical Industries, Inc. B1
Continental Motors Corp. 155
Continental National Bank—Fort Worth 144
Continental Supply Company, The 251-254
Cooper-Bessemer Corp., The 64-65
Coppus Engineering Corp. 3
Core Laboratories, Inc. 63
Coy Co., Inc., Joseph A. 143
Crane Co. 7
Crane Packing Co. 100
Crowder, John H. 243
Crutcher-Rolfs-Cummings 246
Curtin, W. H., & Co., The 279
Daniel Orifice Fitting Co. B57
Darling Valve Mfg. Co. 234
Davis Regulator Mfg. Co., The 136
Dayton Rubber Mfg. Co., The 254
Dearborn Chemical Co. 229
Dickey Clay Mfg. Co., W. S. B36
Douglas-Guardian Warehouse Corp. B18
Dresser Mfg. Co. 253
Dugas Engineering Corp. 134
Economy Electric Lantern Co. B30
Elliott Company 115
Enardo Foundry & Mfg. Co. B46
Engineers and Fabricators, Inc. B11-B26
Erie Bolt & Nut Co. 158
Fairbanks, Morse & Co. B17
Filter Media Corp. B18
First National Bank & Trust Co. of Tulsa, The 261
First National Bank in Houston 114
First National Bank & Trust Co. of Tulsa, The 259
Fisher Governor Company 153-B13-B43-B58
Fluor Corp., Ltd., The 242
Formica Insulation Co., The 240
Fort Worth National Bank, The 144
Foster Wheeler Corp. 36-37-94
Foxboro Co., The 132-133-B12-B13-B23-B31-B41-B-51-B55
Franks Mfg. Co. 270
Frick-Reid Supply Corporation 140-141
Galland-Henning Mfg. Co. B59
Gardner-Denver Company 29
Gaso Pump & Burner Mfg. Co. 139
General American Transportation Corporation, Terminal Division 127
General American Transportation Corporation—Plate & Welding Division 264
General Paint Corporation 116
Girdler Corporation, The 89-B38
Globe Steel Tubes Company 244
Goodall Electric Mfg. Co. B42
Graver Tank & Mfg. Co., Inc. 34-B49
Gulf States Utilities Co. 260
Hadfields, Ltd. B47
Haering & Co., Inc., D. W. B62
Halliburton Oil Well Cementing Co. Inside Front Cover
Hamer Oil Tool Co. B5
Hanlon-Buchanan, Inc. ..... Front Cover
Harnischfeger Corporation 256
Hewitt Rubber Corp. 258
Hill, Hubbell & Co. 116
Horn Co., A. C. B-35
Hudson Engineering Corp. 129-B14
Hughes Tool Co. ..... Back Cover
Humble Oil & Refining Co. 232
Ingersoll-Rand Co. 14-B11-B12-B15-B16-B39-B63
Instruments, Inc. B28
International Harvester Co. 91
Jarecki Mfg. Co. 248
Jensen Brothers Manufacturing Co. 276
Jerguson Gage & Valve Co. B24
Johns-Manville Corporation 31-279
Johnston, M. O., Oil Field Service Corp. 278
Jones Co., The S. M. 257
Justrite Manufacturing Co. 275
Kellogg, M. W., Company, The 15
Kennedy Valve Mfg. Co., The 113
Kent, George, Ltd. 244
Keuffel & Esser Co. 19
Key Company B7-245
Landis Machine Company, Inc. 11
Laughlin Company, The Thomas 122
Leeds & Northrup Co. 238
Lincoln Electric Company, The 69
Linde Air Products Co., The 25
Link-Belt Company 149
Lubri-Gas Corp. B9
Lufkin Rule Co. 119
Lummus Co., The 120A-120B
Lunkenheimer Co., The B55-B56-B58-B59-B60
McEvoy Company 268
McNamar Boiler & Tank Co. B16-B49-B52
McKee & Co., Arthur G. 160
Magnolia-Airco Gas Products Co. 6
Maloney Co., The B7-B37
Mark & Co., Clayton B55-B57
Marley Company, The 9
Marsh, James P., Corp. 123
Mason-Neilan Regulator Co. 32
Mercoid Corp., The B48
Metric Metal Works 50
Midwest Piping & Supply Company, Inc., The 48
Mission Mfg. Co., The 157
Mixing Equipment Co., Inc. 73-B33
National Bank of Tulsa 236
National Carbon Co., Inc. 265
Nelson Electric Mfg. Co. B46-B48
Newman, Hender & Co., Ltd. 142-B60
Norris Brothers, Inc. 275
Norton Company 118
Oxley Engineering Co., Ltd. B50
Pacific Pump Works 39
Parkhill-Wade 97
Parrigin Burners B6
Peabody Engineering Corp. B6
Peerless Pump Division of Food Machinery Corp. 271
Penberthy Injector Co. 52
Perco Division of Phillips Petroleum Co. 150-151
Petroleum Rectifying Company 18
Phelps Dodge Refining Co. 119
Powell, Wm., Co., The 17
%Proportioneers, Inc.% 41
Pure Oil Co. 16
Quaker Oats Co., The 107
Reading-Pratt & Cady Division of American Chain & Cable Co. 35
Rector Well Equipment Co., Inc. 271
Reed Roller Bit Company ..... 102-Inside Back Cover
Refinery Supply Co., The B8
Republic National Bank of Dallas 241
Republic Steel Corporation 10
Robinson Orifice Fitting Co. B31
Rockford Drilling Machine Division of Borg-Warner Company 268
Ross, J. K. 275
Saybolt & Co., E. W. B28-B30-B50
Shand & Jurs Co. 38
Skinner Co., M. B. 137
Smith, H. C., Oil Tool Co. 270
Smith Meter Co. B32
Socony-Vacuum Oil Co., Inc. 24
Solvay Sales Corp. 126
South Bend Air Products, Inc. B17
Southwestern Gas & Electric Co. 135
Stahmer Shoe Co., F. J. B45
Standard Electric Time Co., The B10
Staynew Filter Corp. 44
Stratford Engineering Corp. 33
Stearns-Roger Mfg. Co., The 97
Sterling Machinery Corp. B25-B40
Sullivan Co., The B35
T and L Construction Co. 246
Tank Seal Products Co. B39
Taylor Forge & Pipe Works 22
Texas Pacific Coal and Oil Co. 136
Texas Pipe Bending Co. B36-B37
Timken Roller Bearing Company, Steel and Tube Division 45
Tokheim Co., The B2-B48
Tube Turns, Inc. 110-B19
Tulsa Boiler & Machinery Co. 2
Twin Disc Clutch Co. 252
U. S. Gauge Co. B23
Union Asbestos & Rubber Co. 230
Universal Oil Products Co. 74-B38
Vapor Recovery Systems Co., The B2-B24-B48-B60
Vogt, Henry, Machine Co. 28
Vulcan Steel Tank Corp. B61
Wagner Electric Corp. 269
Warren Petroleum Corporation 125
Watson-Stillman Co., The 159
Webster Engineering Co., The 92
Weston Electrical Instrument Corp. B51
Wheatley Bros. Pump & Valve Mfrs. B57
Whitlock Mfg. Co., The B26-B36
Wilson, Web, Oil Tools 271
Worthington Pump & Machinery Corporation 105
Wyatt Metal & Boiler Works 99
X-Pando Corp. B11
Zink Co., John 117